E ENGINEERING CONSTRUCTION WEEKLY

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July 29, 1937

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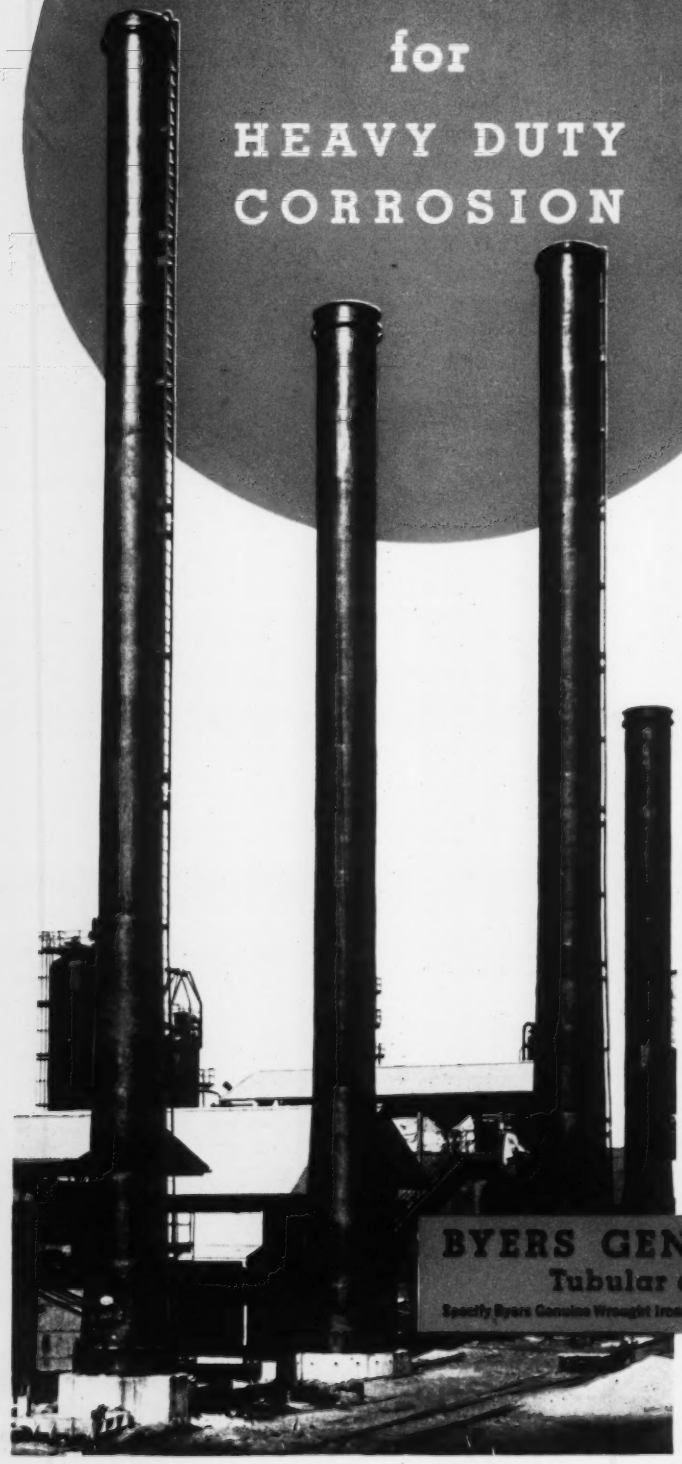
Four Stacks of BYERS WROUGHT IRON for HEAVY DUTY CORROSION



● No tougher smokestack service can you find than where refinery waste gases are burned. An unusual amount of sulphur compounds are present as well as all the other corrosive deposits that result from the combustion of coal or oil.

There was an additional corrosion problem in the case illustrated. These stacks are also subjected to the corrosive atmosphere of salt water. But this job or any other smokestack job is not too tough for Byers Wrought Iron — that's why these four stacks were made of it.

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Much interesting data are contained in the illustrated booklet, "The Use of Wrought Iron in Flue Gas Service." Write our Engineering Service Department or ask a Byers Field Representative for a copy. Also ask for assistance in analyzing corrosive conditions. A. M. Byers Company. Established 1864. Pittsburgh, Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

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Tubular and Flat Rolled Products
Specify Byers Genuine Wrought Iron Pipe for corrosion services and Byers Steel Pipe for your other requirements

Relief – The National Industry

THE VOTING of another $1,500,000,000 for federal relief, to be disbursed at the discretion of the President and the WPA Administrator, involves implications that are beginning to register with the man on the street.

One of the gravest of these is the increasing premium that is being placed on the non-producer and the dependent. Federal relief no longer is a matter of tiding unfortunate people over an emergency; it has become a continuing policy, part of the program to "redistribute the national income." So the question may be stated thus: shall the first concern of the government be to look after the welfare of the non-producer or shall it remain, as heretofore, to do whatever the state appropriately can do to encourage productivity and foster the well-being of the producers?

Some idea of the answer now in the cards may be gleaned from the attitude of the relief administrator. To him the cause of an individual's unemployment or need is of no consequence; no one, as he reads his mission, should be permitted to suffer want so long as anyone else has anything that can be tapped. Moreover, Mr. Hopkins is insistent that "beneficiaries of public agencies must be given a dignified status in society." Those are his words and there you have the philosophy that governs the administration of federal relief.

NO RIGHT-MINDED PERSON will take exception to Mr. Hopkins' humanitarian ideals or quarrel with that part of his ambition which aspires to relieve the distress of those who, through no fault of their own, may come on evil days. But he need not worry about the "dignified status" of such, for he cannot increase or diminish by a particle the standing that they will win as individuals in the communities where they are known. The mere fact that he now feels it necessary to clamor for a "dignified status" for his wards is in itself significant.

It suggests that he must know that millions of Americans in every walk of life resent his persistent repudiation of an ideal in which they have been reared, i.e., that an important quality of good citizenship is the will and capacity for self-support. They do not relish having Mr. Hopkins' private humanitarian ideal supersede by federal mandate their own ideal of self-reliance.

Thousands of American families suffered great privation during and since the depression. But they are not on Mr. Hopkins' rolls. By self-denial and self-help they are keeping body and soul together. They are too self-reliant and too proud to ask of the state, even as a boon, what Mr. Hopkins is teaching others to demand as a right. But for them and the ideals that sustain them he shows scant concern or sympathy.

IT WOULD BE UNFAIR to belittle the very real problems that confront Mr. Hopkins in his job. But if he would insure a continuance of relief to those who really are entitled to it, he should think and talk a little less about the duty of the community to the individual and a little more about the duty of the individual to the community. He should discriminate a little more between those who can't work and those who won't work, and help to reestablish as quickly as possible a respect for the American ideals of self-reliance and self-support. He should try to revive in the American citizen the idea that helping his unfortunate neighbor is an obligation and a privilege and not a political racket.

Then, too, he might prevail on the administration of which he is a part to lay off the productive industry of the country for a few minutes and restore to the producers of our economy the "dignified status in society" that will encourage enterprise and activity.

Thus he might help to expand useful and productive employment that would absorb many now on relief and to increase the aggregate income of business and its employees, which would help to provide what is required for the remainder. But it doesn't make sense to harp on the need for more funds for non-producers, while at the same time cracking down so persistently on the producers, who, after all, are the solitary source of those funds.

Willard Chevalier

ENGINEERING NEWS-RECORD

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Trained lubrication engineers are available for consultation on the selection and application of Texaco Petroleum Products. Prompt deliveries assured from 2020 warehouse plants throughout the U. S. The Texas Company, 135 E. 42nd St., N. Y. C.

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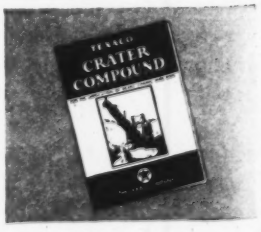

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VOL. 119 *JULY 29, 1937* NO. 5

THIS WEEK AND NEXT

TO RAILWAY ENGINEERS who remember back fifty years the "South Penn" R. R. is a historic recollection. Half completed at a cost of $10,000,000 in a battle between rival railways, the grade and tunnels were abandoned when a truce was signed. Now road transport has interested itself in the abandoned route, completed a resurvey, and planned road structures.

Nature bestowed on Florida an unusually fine roadbuilding material in widely distributed limerock deposits. How the state highway engineers are capitalizing on this gift in wide smooth roads is told by one of them in this issue.

A year ago Harry N. Jenks, sanitary engineer described in ENR a sewage treatment scheme combining characteristics of the trickling filter and activated sludge processes. This method, which he termed "bio-filtration", has been employed in a 1 m.g.d plant, the design and operation of which is described.

The record for high speed in shield tunneling, established at Lincoln Tunnel and described in our pages a few weeks ago, was short-lived. A contractor in Detroit is blazing a new trail in soft-ground boring by shoving a shield 50 ft. every 20-hr. working day.

Finding ample and suitable materials in the Rocky Mountain foothills for a large earth dam was a problem faced by the Denver Water Board. A thin-core design and careful control of materials was the answer, and today the Ralston Dam is nearing completion.

WHAT'S WRONG with waterworks management? Next week, E. G. Plowman gives the answer, and in two following articles offers suggestions for improvements based on a personal survey of 40 water systems.

Night lighting of highways—a series of articles outlining this new science, begins next week.

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THE COVER PICTURE is the center pocket of the shield in the Detroit sewer tunnel where new driving records are being established. The soft blue clay squeezes through the shield openings in continuous ribbons, which are cut into chunks with wire loops.

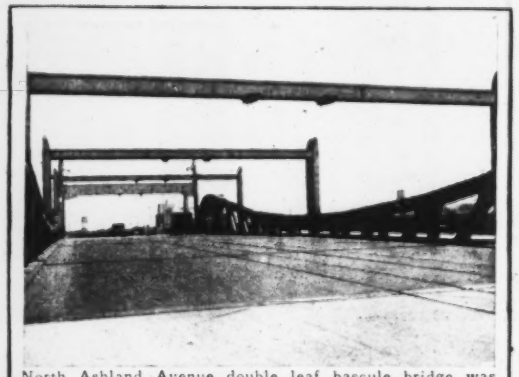
LIGHT
SILENT
DURABLE
NON-SKID

Carey Elastite

ASPHALT PLANK

Paves the Way!

FOR CHICAGO'S INCREASING BRIDGE TRAFFIC



North Ashland Avenue double leaf bascule bridge was paved in 1936 with 1½" Carey Elastite Mineral Surfaced Asphalt Plank.

Year after year, on one bridge after another, Chicago's municipal authorities, engineers and contractors have selected Carey Elastite Asphalt Plank as the paving material that meets the exacting conditions of lift bridge construction.

Combining in a unique way the qualities of light-weight, hardness, toughness and resilience, it is also silent, because of its asphalt and fiber base; non-skid, because of its deeply imbedded mineral surface. Low in maintenance costs, it is easy on the public purse.

To those interested in modern paving problems, specifications and full details will be sent upon request. Write Department *30*.

In 1932, 1½" Carey Elastite Asphalt Plank was applied to the Ogden Avenue Bridge.

Lake Street Bridge paved with 2" Carey Elastite Asphalt Plank in 1928.

1½" Carey Elastite Asphalt Plank applied to LaSalle Street Bridge in 1928.

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BRANCHES IN PRINCIPAL CITIES

THE WEEK'S EVENTS

Bonneville Bill Passes House

Bill puts plant under army control and power sale under administration

The House of Representatives on July 26 passed the Mansfield bill setting up machinery for the disposition of surplus power from the Bonneville project on the Columbia River, scheduled to go into operation late this year. The bill now goes to the Senate.

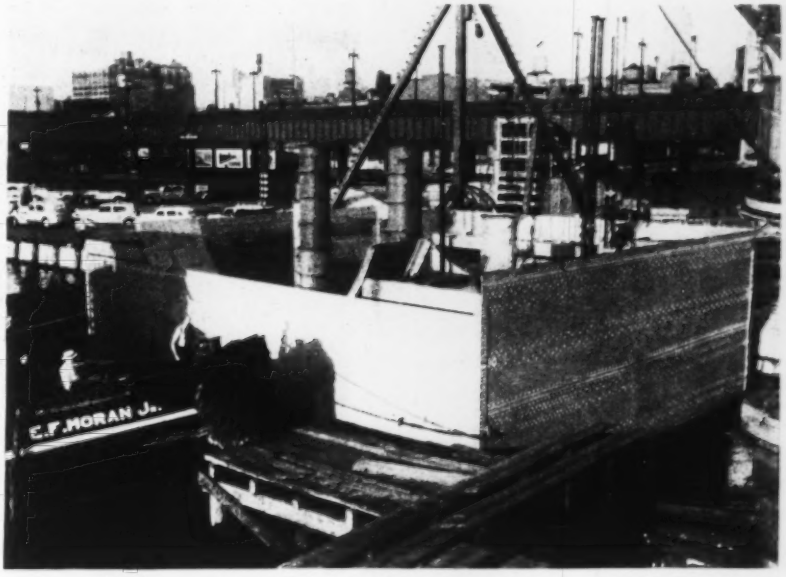
As approved by the House, the bill places operation of the dam and power house in charge of the army engineers, who will deliver power at the switchboard to an administrator to be appointed by the Secretary of the Interior. This administrator will market the power and has authority to buy, build or condemn the necessary transmission lines and other facilities needed to reach a market. Rates will be set by the administrator, but are subject to review by the Federal Power Commission which may, at its discretion, revise such rates before they become effective. Preference is given in the sale of power to public agencies, and the administrator is directed to reserve 50 per cent of the available energy for the use of public distributors until January 1, 1941. Contracts with private utilities will contain a cancellation clause to be used in the event that insufficient power is available to meet the demands of public agencies.

No Boulder revision

The section of the bill directing a re-study of existing power contracts at Boulder Dam was thrown out by the House.

The Senate on July 27 recommitted the McNary bill, which is substantially the same as the Mansfield bill, to its Committee on Commerce, which had reported the bill favorably, with instructions to eliminate the section relating to Boulder rate revision.

Action on several amendments offered during the debate show an interesting contrast. A proposal by Rep. Beiter of New York to turn over the entire project to the Corps of Engineers for operation was defeated 68–17; a contrary amendment giving full control to the administrator was voted down 79–56.



READY FOR A DIVE TO THE BOTTOM OF THE HUDSON RIVER

THE 600-TON cutting edge section of the pneumatic caisson that will form the foundation of the New York ventilating tower for the north tube of the Lincoln Tunnel (Midtown Hudson) was floated to place on July 21. The section, 42x52 ft. in plan and 35 ft. high, was fabricated at the Federal Shipbuilding & Drydock yard in Kearney, N. J., and was towed down the Hackensack River to Bayonne and up the Hudson to the foot of West 39th St. where it is to be sunk by the Mason & Hanger Co., contractor for the tunnel, alongside the south tube caisson just off the New York bulkhead line. Ultimately the caisson will be about 100 ft. high, sections being added as sinking progresses. It is equipped with double steel walls 6 ft. apart, which will be filled with concrete for sinking purposes and to form the permanent foundation walls. The box is fitted with four locks and four air supply lines. Notice the lower part of the circular bulkhead through which the shield will pass after the caisson has been landed on solid rock.

Air has been put on the New Jersey heading of the north tube and the shield is on its way toward the New York shore. The New York shield is being fabricated in a construction shaft some distance inland.

Gholston Discharged From PWA

Jabez G. Gholston, director of the inspection division of the PWA, has been separated from the service without prejudice. It was found that Mr. Gholston had been guilty of lobbying in connection with the emergency relief appropriation act of 1937, which charge was admitted by Mr. Gholston in his answer to the charges on which he was suspended. It is stated that Mr. Gholston, without the knowledge of his superior officers, sent a form of telegram to members of the PWA field staff which they in turn were to cause to be sent to members of Congress over the signature of municipal authorities, contractors, architects, and others in order to influence the action of Congress upon pending legislation.

Administrator Ickes states that although Mr. Gholston's actions in themselves were sufficient to justify the placing of prejudice against his record, they were without wilful intent to violate the law and regulations and prejudice was therefore not placed.

J. R. McGuinness, formerly assistant director of the inspection division, was designated acting director.

Revised Form Of Wage Bill

Wage and hour bill is modified by Senate Labor Committee reducing power of board

The Black labor standards bill has been rewritten by the Senate Education and Labor Committee introducing several important changes. The bill as rewritten limits considerably the discretion of the proposed Labor Standards Board in setting wage and hour standards, introduces a provision for southern wage differentials, and strikes out the controversial section 5 to which labor had registered strong objection, substituting a provision protecting the right of collective bargaining.

A summary of the bill in its revised form follows:

Sec. 1—Legislative declaration of purpose.

Sec. 2.—Definitions of terms. "Employee" is defined to include all employees except those in executive, administrative, or professional capacity, persons employed as seamen or firemen, railroad employees subject to the Hours of Service Act, and persons engaged in agriculture and such processing of agricultural commodities as is ordinarily performed by farmers as an incident to farm operation.

Sec. 3—Creates a Labor Standards Board of five members appointed for staggered terms of 5 years; geographic and industrial considerations guide appointments, which must be confirmed by the Senate.

Sec. 4—The Board shall declare, for such occupations as come within the act, minimum wages as near economically adequate as will not curtail employment, and which will meet minimum standards of living. In declaring such minima the Board shall consider value of services, wages established by collective agreement, wages paid for like work by employers voluntarily maintaining minimum standards; the Board must also give weight to different conditions in localities.

The Board shall declare, from time to time, for such occupations as come under the act, a maximum work week of not less than 40 hr., considering health and efficiency. But it shall be the object of the act to attain by degrees a maximum work week of not more than 40 hr., without curtailing employment. Board must consider the number of persons employed and hours established by agreement.

Sec. 5—Protects collective bargaining and makes clear that the act does not prevent attainment of higher than minimum wages or shorter than maximum hours.

Sec. 6—Provides for exemptions, such as time and a half for overtime, learners and apprentices, disabled persons, seasonal employment, etc.

Sec. 7—Makes it unlawful to sell or ship in interstate commerce goods on which any employee has worked under substandard conditions.

Sec. 8—Authorizes the Board to make orders requiring standard labor conditions in making goods which are not sold in interstate commerce but which compete substantially with fair goods brought from another state. This section also authorizes the Tariff Commission to determine whether an increased tariff should be set up as a result of the operation of this act in various industries.

Sec. 9—Orders may be made only after hearings; the Board must avoid excessive unnecessary classifications; Board's policy shall be to help those who need it, not to interfere where bargaining is effective.

Sec. 10—Hearings shall be held publicly, after notice.

Sec. 11—Requires the Board to appoint advisory committees composed of representatives of employers, employees, and the public.

Sec. 12—Board can investigate, subpoena, compel testimony.

Sec. 13—The Board can sue in U. S. district courts to enjoin violations.

Sec. 14—Requires employers to keep such records as needed to aid in enforcement, and authorizes the Board to require labeling of goods to the same end.

Sec. 15—The Board shall, insofar as possible, investigate through the Department of Labor.

Sec. 16—Empowers the Board to adopt orders and regulations it deems necessary to carry out provisions of the act.

Sec. 17—Declares void all contracts made in violation of this act.

Sec. 18—Provides that reparations shall be paid to employees who have worked for wages or under hours in violation of this act.

Sec. 19—This act shall not justify non-compliance with any Federal, State or municipal regulation imposing higher standards.

Sec. 20—Common carriers shall not be liable for interstate shipment of unfair goods; not excused from obligation to accept goods.

Sec. 21—The Circuit Court of Appeals shall review orders of the Board.

Sec. 22—Confers jurisdiction upon district courts over civil and criminal proceedings under the act.

Sec. 23—Provides penalties.

Sec. 24—A separability clause.

Sec. 25—The act shall take effect immediately, but mandatory features and Board orders shall not be effective until 120 days after passage.

Interior Department Bill Passed

Both houses agree on compromise appropriation measure including Gila project

Final agreement between the Senate and the House on July 26 sent to the White House the bill carrying appropriations for the Department of the Interior during the fiscal year ending June 30, 1938. Passed by the House May 20 and by the Senate June 28, the measure had been in disagreement in respect to several controversial items, including provision for the Gila irrigation project in Arizona and for the Blue Ridge and Natchez Trace parkways.

The Gila project was twice voted down by the House, which finally agreed to approve a reduction from the $1,250,000 provided by the Senate to a compromise sum of $700,000. For the two parkways, the sum of $6,000,000 was approved after the Senate had raised to $7,200,000 the $5,000,000 voted by the House. The House agreed to a Senate amendment authorizing $900,000 for the Grand Lake-Big Thompson transmountain water diversion project in Colorado, but reduced from $300,000 to $200,000 an allowance for studying irrigation possibilities in the Colorado River basin, and cut in half a $200,000 Senate allowance for a general study of reclamation activities.

• • •

Bedrock Reached At Parker Dam

Bedrock was reached July 21 at Parker Dam site in what is stated to be the deepest hole ever dug for the foundation of a dam. Parker Dam, being constructed by the Bureau of Reclamation on the Colorado River, 155 miles below Boulder Dam, will be of concrete arch type, and although it will rise 340 ft. above its foundation, only about 100 ft. of the dam will extend above the stream bed. The remainder will be sunk in the 240 ft. excavation to bedrock.

The first bedrock reached at a depth of 230 ft. below the river bed was described as "wonderful" by the engineers in charge.

Excavation started in October last year when the Colorado River was diverted through two tunnels driven around the dam site through the Arizona canyon wall.

The dam, which is now almost 70 per cent complete, will re-regulate the flow of the Colorado River below Boulder Dam.

THE CURRENT TREND

This week's news of contract volume and construction cost factors

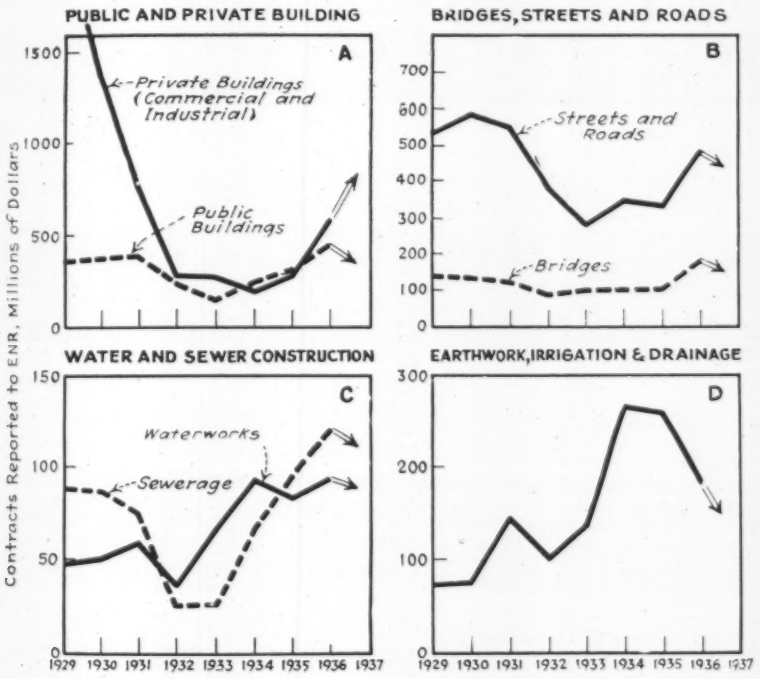
Building Upturn Marks 1937

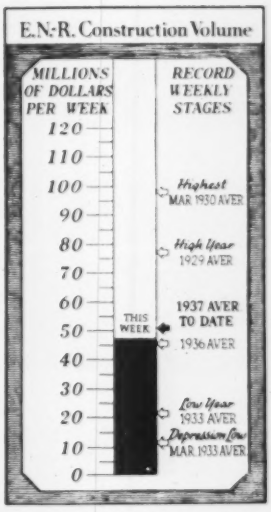
Private building dominates the recovery trend, according to six months' figures

What forces are back of construction recovery is revealed by comparison of current activity with the depression record of individual construction fields. The leader in 1937 activity is private building, as Chart A shows. Commercial and industrial building work dropped to the point of bare survival during the 1932–35 low, but now is so sharply on the upswing as to be the dominating item of construction gain. Residential construction figures follow closely the same trend.

Roadbuilding and bridge work (Chart B), which together form the largest item of public construction, held up well during the depression and show little change now. During the first six months of the current year bridge and road contracts were somewhat below the corresponding figures for 1936, which were unexpectedly high.

Sanitation improvements, in which activity was relatively vigorous during the depression—note in Chart C how sewerage between 1932 and 1934 went up to a new base level—also show slightly lower figures for the six months of '37 as compared with the previous year. Improvement of facilities in these fields is well maintained, however, and no marked decrease is in sight. Earthwork, irrigation and drainage follow a more dramatic depression and recovery course; they are returning to normal from the recovery peak caused by such undertakings as Fort Peck, TVA and Florida Canal.





ENR INDEX VALUES

Index	Base 1913	1926
Construction Cost (July)	241.75	116.21
Construction Volume (June)	245	107

THIS WEEK'S FIGURES

(Thousands of Dollars)

CONTRACTS

	Week Ending July 30 1936	July 22 1937	July 29 1937
Federal	$ 7,588	$ 2,167	$ 3,918
State&Municipal	17,232	12,859	22,545
Total public	$24,820	$15,026	26,463
Total private	9,780	15,600	20,930
TOTALS	$34,600	$30,626	$47,393

Cumulative
1937 (30 weeks) $1,305,429
1936 (31 weeks) $1,347,970

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Week July 29	Cumulative
NON-FEDERAL	$36,758	$917,760
State & mun. bonds	32,533†	341,124†
Corporate securities	42,225	335,460
PWA loans and grants	28,000†	12,035†
RFC loans		29,132
Fed. Aid for Highways		200,000
FEDERAL		57
TOTAL CAPITAL	$36,758	

Cumulative
1937 (30 weeks) $917,817
1936 (31 weeks) $1,193,494

† Includes transfer from federal to private investment financing through sale by RFC of PWA bonds.

Week's Large Contracts

A housing development at Union, N. J. ($2,500,000) and a postoffice garage ($1,561,000) led the list of the week's large contracts. Industrial building contributes a plant of the Scott Paper Co. at Chester, Pa. ($1,250,000), and an oil refinery at Baton Rouge ($500,000). Two New York schools account for nearly two millions ($1,150,000 and $699,000), while a planetarium and science institute of the Buhl Foundation at Pittsburgh adds a substantial item ($750,000). Hartford comes in with a large apartment building ($800,000).

• • •

Power Consumption Rises

Contrary to other statistics, which show slight recessions, electric power production continues to rise. Latest reports show a gain of 8 to 10 per cent over a year ago.

Civil Engineers Meet in Detroit

Highway transportation and super-highways form principal topics at annual summer convention of Am.Soc.C.E.

THE FUTURE of highway transport and the place of the super-highway in our transportation system formed the principal technical subjects considered at the 67th annual convention of the American Society of Civil Engineers held in Detroit July 19-22. Other subjects considered were the development of the transportation system for the Great Lakes, sub-surface utilities, tourist camps and roadside sanitation, and the proposed Mackinac Straits bridge. A fuller report of the technical session will be published in next week's issue.

On the professional side, the union movement among engineers and the status of the young engineer were considered at some length.

The convention was unusual in that neither the president, Louis C. Hill, nor the secretary, George T. Seabury, were on hand, both having been ordered by their physicians to take an extended rest, and both being abroad during the convention. Edward Lupfer, vice president, acted for Mr. Hill and C. E. Beam for Mr. Seabury.

Act on union movement

The board of direction met at Ann Arbor, Mich., Monday and Tuesday for its regular summer meeting, and on Tuesday afternoon a conference of representatives of local sections of the northern region was held in the same city so that the directors could participate. Subjects discussed at this conference were the union movement among engineers, proposals to assign all members to local sections of the society, integration of the activities of corporate members, juniors and students, and local publicity for engineers. A considerable part of the time was devoted to the unionization movement and at the conclusion recommendation was made to the board that it appoint a committee at once to make a thorough study of that subject as it affects the American Society of Civil Engineers.

The same subject was brought to the fore at the opening session of the convention in the presidential address of Louis C. Hill, the address being presented by vice-president Lupfer. Mr. Hill laid no small amount of responsibility for the present low economic level of many engineers right at the door of the employer-engineers. These men, in an effort to keep down engineering costs, have paid low wages to their employees or, where they were in executive positions in large organizations, have not taken every opportunity to recommend higher pay for the men under them. Mr. Hill said in part:

Employers held responsible

"It should be obvious that this trend toward trade unionism, if permitted to continue, will destroy whatever standing the engineer has obtained as a member of an acknowledged profession. Hence, it is imperative that we consider what line of action is available to us other than the direct action of collective bargaining.

"It is evident to me that the answer lies in recognition of the responsibility of each engineer to his subordinates. I wish to emphasize that point: It means that most of the members of this society must assume, actively and individually, the obligations of the dual function of employee-employer. Such a duty goes far beyond the administration of the work of engineers subordinate to him; it involves real concern for the working conditions of those subordinates and for the monetary and other rewards they receive for the work which they do.

"With full appreciation of the altruism, ideals, and ethics of our profession, we must admit that the desire for money, with the power and security that money gives, is the controlling motive of modern civilization. Rightly or wrongly, the world today measures its recognition of the work of the individual by a money standard. Such being the situation, it is desirable and proper that each engineer should further the interests of every engineer subordinate to him by emphasizing to his superior or employer the importance of the engineering problem, the accuracy of execution, the responsibility, and the integrity of purpose that characterize the work of his subordinates. Just as often as he does so, he will take a positive step toward improvement of the status of his profession and at the same time promote his own well-being. On the contrary, each time such an engineer understates the worth of engineering services, he does positive injury to the profession and to himself.

"In this latter category falls the consulting engineer who obtains work on the basis of its cheapness, and thus is required to hold down the rates of pay to his subordinates. The engineering executive of a governmental agency who promotes the use of his personnel by political subdivisions at costs to them which cannot be met by engineers in private practice likewise does a direct injury to the engineering profession. Similarly, each time that the chief engineer of a corporation reports to the executive officer that he has saved money by employing engineering talent at the market price for skilled labor, he belittles his profession, and he brings nearer the day when he himself becomes only the foreman of such labor, an honorable but not a professional position."

Notable speeches

Three notable speeches were made at dinner and luncheon meetings during the convention. The first was that of Charles F. Kettering, president, General Motors Research Corp. Departing extensively from his prepared address on motor vehicles and highways of the future, Mr. Kettering gave his hearers a thought-stimulating outline of the vast possibilities of research in the future development of the country, especially in the highway field, of which Mr. Kettering said both the road builder and the motor car builder were an integral part. Road builders among his hearers found great satisfaction in his statement that the motor car builder had a great advantage over the road builder in keeping up to date because, whereas the life of a motor car is only seven years, a life of at least three times that length is demanded of a highway. Under the circumstances, he said, we cannot expect the same perfection in highways that we seek in motor cars. He said that the most we can expect from the highway builder is intelligent planning for the future so that what he does today will not handicap the road builder and motor car builder of tomorrow.

In a somewhat similar vein, W. B. Stout, airplane designer, told of what the application of airplane-design technique to the design of railroad cars, autos and buses had accomplished in weight elimination and pointed to the limitless possibilities for still further improvement that will come when we learn how better to use metals and plastics in the design of structures in which weight elimination is an important factor.

Administrative functions

From a quite different angle and on a quite different subject, Arthur Morgan contributed to the broad thinking of the convention. Taking the TVA as indicative of a trend toward increased government participation in economic affairs, Dr. Morgan urged upon his hearers the responsibility of the engineer in assuring that the administration of economic functions taken over by the government shall be on the high

SAN GABRIEL DAM NO. 1 of the Los Angeles Flood Control District which was completed July 21. It is the highest rockfill dam ever built.

plane on which engineers expect to carry forward their work in private undertakings. As an example of what might be done, he cited the manner in which the U. S. Bureau of Reclamation has been conducted.

The engineer stands in a key position in such undertakings, Dr. Morgan said, and he must be prepared, if necessary, to take a stand that may cost him his job.

Society business

Four proposals for amendments to the constitution of the society came up at the business meeting for a decision as to whether they should go to ballot of the membership. One, modifying the method of nominating officers, was referred back to the board with a recommendation that a committee be appointed to report on revising the entire section. Three other proposed amendments, two of which relate to changes in junior and student grades, and one which authorizes an increase in the number of honorary members to be elected in any one year, were authorized to be sent to ballot with a statement giving both sides of each proposal.

At the business meeting the recommendation of the local section's conference in regard to a study of the union movement was put into the form of definite instructions to the president to appoint a committee to make the study. Thus it will be possible to get the study started before the board meeting in the fall.

A variation in the usual program was inaugurated at Detroit. Instead of holding technical sessions all day on Thursday and devoting Friday and Saturday to inspection trips, technical sessions were held Thursday and Friday morning, leaving the remaining time free for trips to points of interest.

Pittsburgh Incinerator Bids Voided

Incorrect copies of specifications, sent to one of the bidders, has caused the city of Pittsburgh to throw out all bids received May 27 for construction and operation of a garbage incinerator for the city. It was announced that new bids would be advertised in the near future.

At the same time, George W. Schusler, superintendent-engineer of the city sanitation bureau, was discharged for failing to report the discrepancies in specifications, of which he was said to have had knowledge.

At time of discovery of the error, the city council was about to take action on Mayor Scully's recommendation, based on the bids received May 27, that the bid of the Koppers Construction Co. for construction and operation of an incinerator and of the Terminal Service Co. for hauling and collecting garbage be accepted. Then it was discovered that specifications sent to the Allegheny Garbage Co., which now holds the contract for disposing of the city's garbage and which has submitted bids for the proposed incinerator, were different from those sent to other bidders. At points where the standard specifications showed that bids had been asked for "hauling and depositing" garbage, the specifications given to the Allegheny company read "hauling and disposing."

The city solicitor ruled that if a contract were awarded on the basis of the May 27 bid, litigation would be likely to arise.

Mr. Schusler protested against his discharge and asserted he had informed the mayor of the discrepancies in the specifications at the time when the bids were received.

San Gabriel Dam Completed

Rockfill structure of dam No. 1 is completed, leaving only control structures to be built.

The last rock was placed in the $16,860,000 San Gabriel Dam No. 1 of the Los Angeles County Flood Control District on July 21. The rockfill structure, which rises 355 ft. above bedrock, is 2,000 ft. thick at the base, and has a crest length of 1,670 ft., contains 10,572,000 cu.yd. of rock. It is the highest dam of this type ever built.

The project had its inception Jan. 15, 1933, when a contract was signed between the Los Angeles County Flood Control District and the West Slope Construction Co. for construction of a rockfill dam about three miles below the abandoned Fork Dam site in the San Gabriel Canyon. This was intended to be a dry rockfill type dam to consist substantially of large hard rock to be secured from a quarry located on the east side of the canyon about a half mile below the dam. However, upon stripping and opening the quarry it was found that rock satisfactory in accordance with the specifications was not available in sufficient quantity and that rock to be wasted would be far greater in volume than rock available for construction of the dam.

Due to these conditions, work was shut down in October, 1934, after about 455,000 yd. of rock had been placed. During the shutdown a new design was prepared by the district, and on July 26, 1935 a supplemental agreement was entered into between the district and the West Slope Construction Co. covering the revised design.

Under the revised design, the upstream and downstream slopes were flattened to 3 to 1 instead of the previous 1½ to 1 and the cross section of the dam was divided into zones, comprising a core of mechanically compacted quarry run material, a clay-sand zone upstream of the core, and a zone of quarry run material on the extreme upstream side. On the downstream side quarry run material was placed grading from fine to porous at the extreme downstream side.

On July 13, 1937, the dam proper was complete except for a few truckloads of rock which were dumped during the ceremonies July 21.

An average of 460,000 cu.yd. of material per month was placed in the dam over the period from August, 1935 to July, 1937. The highest production was 964,556 cu.yd. in May, 1937, which is believed to be a world record for dams of this type.

New Building Code For New York

Final action is taken on code which has been pending for five years

For the first time in 21 years New York City received a completely revised building code with the passage by the Board of Aldermen of the revised building code which has been held in committee since 1932. The new code liberalizes many provisions of the building law of New York City, making less expensive construction possible in many instances. Working stresses in structural steel are raised from 16,000 to 18,000 lb. per sq. in., and welding of building frames is permitted. A new type of fire retarding construction is introduced which may be used to a height of nine stories; previously the only alternative to completely fireproof construction was the non-fireproof building which was permitted as high as six stories. Stricter provisions govern the use of wood in building construction, and provisions for separation of wooden buildings are introduced.

In its administrative provisions, the new code imposes responsibility for conformance with code requirements upon those filing plans and constructing buildings rather than leaving the entire responsibility to the plan examiner or inspector.

The new building code has been in preparation since 1928. At that time the Merchants Association of New York, following a suggestion of the Mayor, appropriated $75,000 to cover the cost of drafting the code. Drawing of the code was completed in 1932 and the measure was then transmitted to the Housing Committee of the Board of Aldermen. In spite of many meetings, the committee was unable to reach an agreement until last June (*ENR*, June 24, 1937, p. 930), when the measure was finally reported to the Board of Aldermen.

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Highway Department Shakeup in Michigan

A shakeup in the Michigan State Highway Department has brought about a number of promotions and changes, resulting in a $30,000 increase in the payroll.

G. D. Kennedy, who was business manager and consultant, becomes deputy in charge of business administration. V. B. Steinbaugh becomes deputy, and Harry C. Coons deputy in charge of construction. Edward Schwoppe and B. R. Downey, both former district engineers in the Cadillac district, become assistant maintenance engineers.

Harold Zumstein is made engineer in charge of a separate metropolitan district, created for Wayne County. A department branch was made at Escanaba, with Benjamin F. Sparks, present upper peninsula engineer, in charge. William H. Harvie, former district engineer in the Grand Rapids district, becomes state road engineer with offices in Lansing. T. L. K. Donnelly, former assistant district engineer in charge of maintenance in the Saginaw district, was transferred to the construction division, together with N. W. Paquette, assistant engineer at Crystal Falls. R. A. Beer of the Kalamazoo district and H. F. Rye of the Newberry district, district engineers, were appointed assistant road engineers. Finally, M. J. Walker, assistant district engineer for the WPA was made assistant road engineer.

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Contract for Sewer Under Buffalo Harbor Awarded

The Buffalo, N. Y. Sewer Authority awarded contract July 23 for the construction of the Black Rock Harbor crossing, a link in the $15,000,000 Buffalo sewer project, to the L. A. Wells Construction Co. of Cleveland on its low bid of $382,000. The contract covers the construction of two tubes, each 8 ft. in diameter and 507 ft. long, from the mainland to the Bird Island pier, site of the sewage disposal plant. The tubes will carry all of the city's sanitary sewage to the treatment plant. Communication wires will be encased in the tubes.

The original bids for the tunnel were rejected when they ran $200,000 higher than the estimates. Since that time, however, the War Department has granted its consent to construction of cofferdams in the harbor, which materially reduces the cost of the job.

This new contract brings the total contracts awarded in connection with the Buffalo sewer project to a value of $12,008,000. Twenty-eight contracts are either completed, under construction, or awarded but not under way. Seven contracts, amounting to $1,541,000 have been completed.

Nine contracts remain to be awarded, including construction of an auxiliary interceptor and pumping station at an estimated cost of $250,000, modification of existing sewers at a cost of $60,000, the Hamburg St. pumping station to cost $50,000, a $115,000 outfall structure, and an administration building to cost $348,000.

Bids are to be advertised this week for the overflow conduit and outfall structure of the treatment plant.

Competitive Cement Bids Received in Texas

The award of a contract July 26 for manufacture and delivery of 250,000 barrels of low heat portland cement for use in construction of Marshall Ford Dam on the Colorado River of Texas near Austin, Texas, to two Texas companies was based on the receipt of four competitive proposals.

The Republic Portland Cement Co. of San Antonio, Texas, the lowest of four bidders, received a contract to supply 75,000 barrels at a net cost to the government of $1.96 per barrell and a total cost of $147,000. This company bid only on part of the cement for which offers were requested in the advertisement.

The Trinity Portland Cement Co. of Dallas, Texas, contracted for the remaining 175,000 barrels at a net cost of $1.99 per barrel or a total of $348,000. This company was the second low bidder.

Commenting upon the competitive nature of the bids received, Secretary Ickes stated: "The fact that we obtained truly competitive bids on this cement is gratifying. It was only a little more than a year ago that the Bureau of Reclamation called for bids on a similar quantity of cement for another dam on the Colorado River of Texas and received four identical proposals. The successful bids today, it might be noted, were lower than the identical bids received in 1936, despite the fact that a special cement is involved, the low heat variety."

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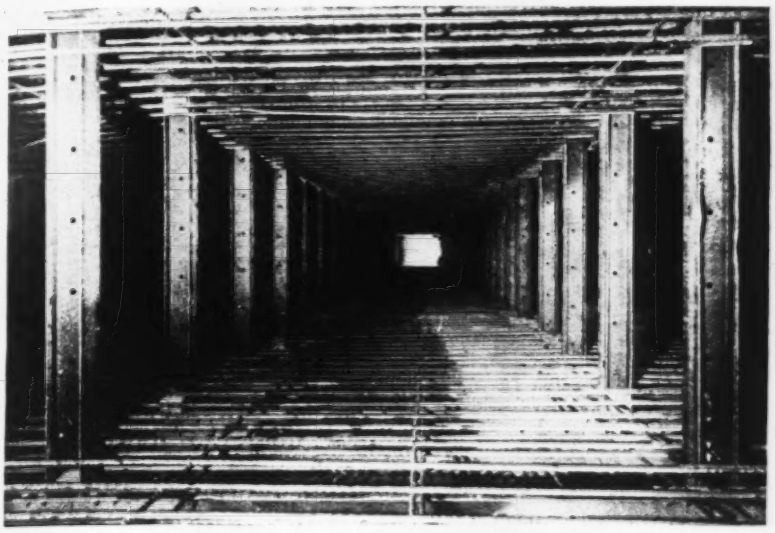
Work Stops on Boca Dam To Forestall Strike

All work on the $1,000,000 Boca federal reclamation project on the Little Truckee River near the California-Nevada state line has been at a standstill since July 14 when the George W. Condon Co. of Omaha, contractors on the project, closed the job after CIO organizers had attempted to organize the workers. The move was made in the expectation that collective bargaining demands would be presented and that a strike might be called by members of the Boca Tunnel and Construction Workers Local No. 402, a CIO affiliate.

Meanwhile, a number of the discharged workmen are occupying the bunkhouses and patrolling the project. Company officials are conferring with A.F. of L. representatives and it is reported they may attempt to reopen the project with A.F. of L. men. An investigation is being made by examiners of the Labor Relations Board.



AN ANCHOR FOR FORT PECK DAM SPILLWAY

THIS LOOKS like a section of New York's subway, but in reality it is one of the 8-ft. wide trenches sunk 134 ft. into the shale as part of the cellular cutoff wall at the lower end of the lined section of Fort Peck Dam spillway. Because of the tendency of the shale to disintegrate as soon as exposed, it is necessary to treat the excavated surfaces with a bituminous solution, then apply a corrugated metal lining. Heavy steel members are required for support of the ground, and the concrete will be heavily reinforced, as can be seen. This view is looking toward China, for that is a spotlight on the bottom in the distance, not the sky as might be supposed. The joint firm of Addison Miller and Fielding & Shepley, of Minneapolis is building the cutoff wall under the direction of Cap Brinton, superintendent.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

CURTAILMENT of the federal building program is forecast as the result of a White House conference between President Roosevelt and Rep. Woodrum of Virginia, chairman of the appropriations subcommittee preparing the third deficiency bill. The President is reported to have taken the position that all unnecessary building plans should be eliminated.

The third deficiency bill had been expected to carry appropriations for a new War Department building, a structure to house the Social Security Board and its employees, and a memorial to Thomas Jefferson, all to be located in the District of Columbia, as well as numerous post offices and other federal buildings elsewhere. Complete elimination of all of these is not expected, as many are urgently needed, but undoubtedly the economy drives will result in a considerably smaller appropriation.

Congressional action was completed by the House of Representatives on July 19 on two bills granting a federal approval to the creation of a Maine-New Hampshire interstate bridge authority and authorizing it to build and operate a rail and highway toll bridge over the Piscataqua River near Portsmouth, N. H.

Congressional action was completed on July 21 on a bill authorizing the construction, under the reclamation law, of a reclamation project on the Arch Hurley conservancy district in New Mexico. The project covers canals and other facilities serving approximately 30,000 acres of grazing land. Water is available at Conchas Dam.

Plans are being made for a study of low-cost housing construction to be conducted by the Bureau of Standards over a two-year period. The study will be financed by a special appropriation of $200,000 contained in the last Department of Commerce appropriation. Detailed plans have not been completed, but it is known that the work will be limited to laboratory and economic studies of materials and methods, and will not involve the construction of sample dwellings.

Housing Bill Reported

Revised Wagner Bill offers choice of grant or annual subsidy and loan

The Wagner Steagall low-cost housing bill was reported to the Senate July 23 with a recommendation for its passage by the Senate Committee on Education and Labor. In its revised form the bill reduces the amount of bonds to be issued by the proposed national housing authority in the next 3 years from $1,000,000,000 to $700,000,000. The bill carries an appropriation of $26,000,000 for the first year.

Greatest change introduced by the committee is a provision that local housing authorities, if they wish, may receive an immediate grant which can not be more than 25 per cent of the cost of the project in cash, plus 15 per cent of the project cost through payment of labor, bringing the total possible subsidy to 40 per cent.

The capital grant procedure is introduced as an alternative to the original plan of continuing annual subsidies sufficient to keep rentals low. The bill provides that the maximum annual contribution under the subsidy plan shall not be more than $3\frac{1}{2}$ per cent of the project cost. The committee changed the provision for 60 year subsidy contracts to provision only for 20 year contracts. At the end of 20 years the contracts may be revised by the national housing authority.

The provision for loans to local authorities at the going federal rate of interest is retained unchanged.

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Single Bid on Ruby Dam Exceeds Estimate

A joint bid submitted by three firms was the only one received by the Seattle board of public works July 22 for construction of the Ruby hydroelectric dam on Skagit River.

The bid, which was submitted by the General Construction Co., of Seattle, J. F. Shea, of Portland, and the Columbia Construction Co. of Bonneville, Ore., covered construction of the dam to an elevation of 1,280 ft. and was for $3,968,000. This figure is $437,000 in excess of the engineer's estimate.

The lowest of two bids submitted on a separate contract for furnishing 276,000 barrels of cement was offered by the Superior Portland Cement Co. of Seattle, which asked $1.88 a barrel for 275,000 barrels in bulk and $2.38 a barrel for 1,000 barrels in sacks, bringing the total bid to $530,000.

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Crown Formula for Roads

Sir—The "Better Crown Formula for Roads" given in *Engineering News-Record*, June 17, 1937, page 922, is certainly an improvement over the old parabolic formula so far as the shape of the resulting curve is concerned. However, the construction of similar improved crown sections has been practiced many years.

While a city engineer fifteen or twenty years ago, the writer clipped the accompanying diagram showing a "New Crown Section, Chicago Pavements," which he has used ever since, both on construction and in teaching highway engineering. Several years ago it was suggested to and adopted by the Wyoming state highway department for use where the state was constructing pavements within city limits on through highways. Unfortunately, the magazine reference has been lost and the complete description of this crown section is not at hand.

However, the method of computing the offsets from the tangent to the curve at the crown point is very simple and easily explained. The distance from the crown to the curb or edge of pavement, is divided into any convenient number n of equal parts. If m is the number of any offset, counting from the crown where the offset is zero, the increment in the numerator of the fraction of the total crown height, used to compute the offset, is given by the formula $(2m + 1)$. This gives for these increments the series of odd numbers (omitting unity) which appears on the top line of the figure. The numerator of the fraction is the sum of these odd numbers from the crown to the given offset, while the denominator is the sum from the crown to the curb. Expressed in a mathematical formula, the r^{th} offset would be

$$\sum \frac{1}{r}(2m+1) \div \sum \frac{1}{n}(2m+1),$$

multiplied by the crown height.

Laramie, Wyo.
June 23, 1937

R. D. GOODRICH
Dean of Engineering
University of Wyoming

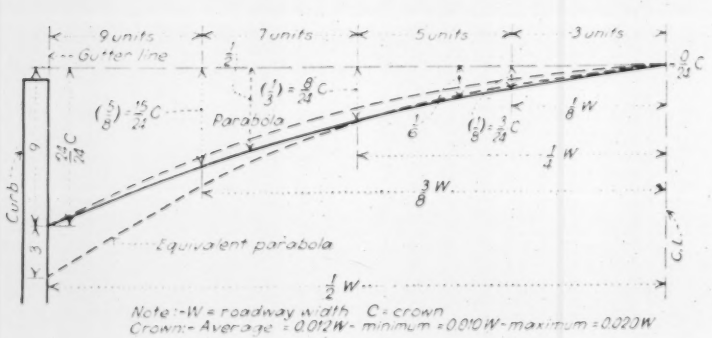
Workability Tests for Mortars

Sir: We have been interested in the paper of Ed. W. Scripture on Workability of Concretes and Mortars (*ENR* July 1, 1937, p. 17). The author presents a number of cogent points. We wish he had been more specific in discussing "a number of materials of a colloidal nature. . . . which will very greatly increase **workability**. . . ." and which presumably do not interfere with other properties of the finished concrete.

The author suggests the application to concrete and mortar of the flow-shear concept applied by Bingham to plastic materials. Some years ago we attempted to determine the yield values and mobilities of mortars and cement pastes, but in most instances the data yielded highly curved lines (stress vs. flow), which obviously could not be used to obtain either yield point or mobility. The explanation, we think, is that while these concepts may perhaps be applied to essentially homogeneous plastic materials, cement mortar or paste cannot be so classed. We question, therefore, whether the simple flow-shear conception can be applied to cement mortar or concrete without considerable reservation.

Riverside, Calif.
July 8, 1937

HUBERT WOODS
Chemical Engineer,
Riverside Cement Co.



Record Span Rigid Frames

Question has arisen by correspondence about the accuracy of a statement in J. A. Dunford's article (*ENR* June 24, 1937, p. 939) concerning record length of rigid frame bridge spans. Cited as basis for the question is a description of the Lincoln Park Bridge at Kenosha, Wis. (*ENR* Jan. 28, 1937, p. 127).

Mr. Dunford's article speaks of the 175-ft. span of the Schmitz Park Bridge in Seattle as representing a "60 per cent increase in length over the country's previous record for length of span of this type." As this manuscript reached the editor's desk the exact wording was "***previous record for length of *highway bridge* span of this type." The italics indicate words that were omitted in the process of editing.

The bridge at Kenosha is a rigid frame of 146-ft. span intended primarily for pedestrians but the roadway, 10 ft. wide between curbs, is also for use by trucks and other park maintenance equipment and hence the design was for an *H*-10 loading. The Kenosha Bridge, strictly speaking, is not a highway bridge and so far as we know Mr. Dunford's statement, which he intended to apply only to highway bridges is correct.

—EDITOR

Flat Slab Building Costs

Sir: So many inquiries have been received regarding cost data on construction of the Glen Park School in San Francisco, described in *Engineering News-Record* June 17, 1937, p. 918, that publication of more detailed information on costs seems to be in order.

Actual cost of the new building to the school district included the following items:

Contract cost of the structure..	$166,138
Contract cost of plumbing work.	18,037
Contract cost of electrical work.	9,783
Total	$193,958

However, the first item on this list

includes about $4,000 for work (yard grading, etc.) peculiar to this particular site which should not be included in building cost that is to be used for comparative purposes. Accordingly, a total cost of $190,000 was used for the complete structure without furniture or equipment.

As there are several methods of computing unit costs on the square foot basis, the method used in determining the area for the unit cost of this case is indicated in the following:

Basement (storeroom, toilets and boiler room)	2,000 sq. ft.
First floor	15,300 sq. ft.
Second floor	15,600 sq. ft.
Roof	15,600 sq. ft.
Total	48,500 sq. ft.

$\frac{\$190,000}{48,500} = \$3.92$ per sq. ft.

With this information it is possible to figure the unit costs in whatever way may be useful for comparison with costs worked out by other methods.

July 10, 1937 — HAROLD B. HAMMILL
San Francisco — Structural Engineer

Supervision of Building

Sir: E. E. Seelye's article on the Bronx apartment house collapse and your editorial entitled "Unsafe Building," in the July 15 issue, contain a great deal of interest. In attempting to secure legislation on this important matter we are handicapped by the attitude of the local legislators, who either cannot or will not understand the fundamental principals on safety.

On June 29 the New York Board of Aldermen passed the Gross bill, requiring supervision but permitting the owner to substitute a licensed building superintendent to supervise in place of the architect or engineer. This would mean that the speculative builder could take out a license as a building superintendent and supervise his own work. Fortunately we were able to get the Mayor to veto this ordinance.

It is now necessary to make a fresh start. The state education law, under which architects and engineers are licensed, makes it mandatory on public work throughout the state that supervision shall be done by the architect or engineer making the design. It would be a fine solution of this problem if the next legislature could be persuaded to extend the requirements to private work as well.

New York City, July 19, 1937 — AUBREY WEYMOUTH, Chief Engineer, Post & McCord

Sir: Mr. Seelye's article raises the question of what should be done to make buildings safe. My general opinion is that nothing can be done that will make the matter foolproof.

It would be a great advantage if an arrangement could be made that would place the responsibility for safety on some one individual—be he the architect or the structural engineer—to include not only design but actual construction. Then, if the building did not prove to be safe they would not have to point the finger around indiscriminately at owner, builder, subcontractor and building department, but there would be one man responsible.

While the conviction of those involved in the Bronx case has undoubtedly had a salutary effect, I think that the owner who wants to build cheaper than he should at the expense of safety and any other consideration will probably continue to do so. We have never been able to legislate enough to prevent murder or theft and probably will not be able to legislate enough to produce building safety. Every failure has a salutary effect, and certainly the Bronx failure has produced a very strong effect in the building department; yet we can never depend on the building department for absolute safety.

New York City, July 16, 1937 — H. G. BALCOM, Consulting Engineer

Professionals Need to Organize

Sir: Have been reading the pros and cons of whether engineers should organize or should remain professionals (and hungry!). It is astonishing that for the glory of being a "white-collar stiff" men will forego money in the pay envelope, shoes on the feet of the Mrs. and food on the table for the children.

What's wrong with the men who organize the construction industry—a group of men whose whole training is organization, of men, of materials, of machinery, of transportation and of energy, and yet who do not apply the practice to themselves?

You get a pay envelope? Then you are a wage worker, whether it carries $22 a week or $60,000 a year. In the division of the output of industry between capital and labor you belong to either one side or the other. If the one side is organized, the other also must organize.

I talk like a man who has carried a bridgeman's card for 22 years. But, if you prefer, take it from the professional man's angle. Would you like to make as much money as Cagney, Robeson, Hepburn and other professionals? Their A.F.L.—Actors' Equity membership does not detract from their professional standing; or does it?

There are bar associations and medical associations. Why should there not be engineering associations?

However, organization like that carried on by the C.I.O. is seldom permanent, because the men in an industry or profession who are organized by outside influences lack the conviction of "United we stand and divided we fall." They not only lack conviction but they lack mental energy, initiative and enterprise, and it is here that exploitation by the professional labor boss mentioned by you may enter.

Rushland, Pa., July 16 — JAMES J. MARTIN

Thinks We Are Biased

SIR: Presumably *Engineering News-Record* is in favor of advancing engineering to a dignity comparable with medicine and the law, and whereas it is a fact that compensation paid employee-engineers closely approximates coolie and peon levels, and whereas all appeals to employer-engineers to remedy such a condition, based on ethical grounds, appear to meet with no marked degree of enthusiasm, may I not ask what precisely you had in mind in commenting and "clarifying" previous statements in regard to the topic of the unionization of engineers, when you make the amusing pronouncement that such unionization would widen the gap between employer and employee-engineer and that such gap-widening would be highly *undesirable*, and if it is not a fact that what you really meant is that it would be *undesirable for employer-engineers*?

Park Ridge, Ill., July 19, 1937 — WILLIAM STACK, Registered Professional Engineer

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JULY 29, 1937

LOUIS C. HILL showed keen appreciation of what is the major problem facing the engineering profession today when he took the union movement in engineering as the subject of his presidential address to the American Society of Civil Engineers in Detroit last week. As Mr. Hill pointed out, the movement has in it a threat to the professional status of the engineer, because if the movement should expand to include large numbers of engineers in groups that are generally recognized as trades then the public will find it difficult to see why engineers should claim professional status at all. Therefore the movement is one to concern all engineers. How it is to be met Mr. Hill did not attempt to state fully, but he rightly pointed out that a good beginning can be made by the employer-engineer through aggressive effort to get better pay for the men under him. The suggestion goes to the very heart of the profession's internal problems, in fact, and deserves everyone's careful and conscientious thought.

South Penn's Possibilities

IN THE SOUTH PENN ROAD described in this issue Pennsylvania has set an example of bold and unusual highway planning. A toll road 200 miles long to cost $60,000,000 goes beyond any previous conception of policy. Justification of such an unusual plan lies in the claim that it will provide faster, freer and safer road service. At present the details are not available to show in what respect these are assured. The flatter grades and better alignment, granting all that is claimed for them, will not give express service unless traffic is isolated and restricted, for a road is not an express road merely because it is wide and straight. Under toll-road operation much traffic will go elsewhere to avoid toll charges, but if the ambitions of the promoters are realized the new road will not long be a private enterprise. Under public operation, free, it will quickly lose its express-road qualities unless these are built into the road in the original design. At present the new trans-mountain highway ranks merely as an example of bold road promotion; it remains to be seen what the engineers will do toward giving it true express highway rank through designing it as a permanent freeway and thereby assuring its efficient transport service.

Fast Tunneling

FOLLOWING SOON AFTER the first tube of New York's Lincoln Tunnel, where new shield-driving speeds were reached, the progress of the Detroit sewer tunnel at even greater speed is proof that the art of soft-ground tunneling is steadily advancing. At New York it was new and improved equipment that paved the way for fast driving; at Detroit it is remarkable coordination of procedure and judicious use of rather common-place plant items. Concrete-block primary lining contributes to the progress at Detroit, for the usual time-consuming bolting of the iron is eliminated, and a clever new closure or key segment further speeds up the erection of the lining. But a car dumper, efficient trackage and hauling arrangements, and a fine form layout and concreting system, are major items that make progress at Detroit outstanding. The steady run of 50 ft. and a high run of 67½ ft. per day is a tribute to the contractor's handling of the work. The speed figures attained constitute a world's record for sustained progress of shield work.

Are They Bases?

THE LIMEROCK ROADS of Florida described in this issue are outgrowths of a road policy now being intensively developed in many states having lean supplies of the traditional road metals. Fortunately Florida has little to do to its local material to fit it for compaction, but other states have found adequate substitutes in stabilizers. By their aid sands and earths are being converted into foundations and bases that have all the stability of the old macadams. And this brings up a question of nomenclature. It is common to speak of these road tops of stabilized soil as *bases*, even when they are covered with no more than a sprinkling of bitumen and fine stone. Yet in their essential service, except perhaps as to abrasive resistance and waterproofing, they are in fact the surfacing structure. If this service function is kept in mind as it has been in Florida practice, it will help to avoid the flimsy jobs of stabilization that tend to become common in the effort to utilize local materials.

Ends Well

A STORMY CAREER of a dozen years or so came to a good end for San Gabriel Dam No. 1 last week when formal dedication marked completion of the huge embankment. The event is important because it means protection for the populous Los Angeles County area hitherto menaced by the San Gabriel's floods. It gains greater importance and distinction because the new dam-building method that was used brings a major addition to the art. After the

original project for a great concrete dam at the Forks site had failed, and still more so after its successor project for a conventional rockfill dam at a new site lower down had also failed, both failures being due to fissures and shattered rock, there was grave question as to how the needed flood control might be obtained. Resourceful adaptation of design to available material thereupon led to the construction procedure now successfully carried through. Fine and coarse rock material was so combined and compacted as to form a dense core, and a water-stop layer and protective riprap were added. The resulting embankment has unusual solidity, as tests showed, and though proof by impounded water is still pending there can hardly be question of its stability and tightness, nor of its freedom from the troublesome settlements experienced in the rockfill used in Dam No. 2, some miles up the gorge. The new embankment type combines the best practices of earthfill and rockfill construction, and since it embodies meritorious features of both it may suit a wide range of conditions. That it can compete in cost with other methods is suggested by its remarkably fast construction, result of highly efficient organization of excavation, trucking and compacting.

From the Dark Ages

MEDIEVAL IS THE WORD that best describes the hog-feeding method of garbage disposal. For a nation that lays claim to rapid application of scientific developments and preservation of high health standards, it is strangely inconsistent to report that the noisome hog-farm is the favored means for "disposing" of community food wastes.

The method stands universally condemned because of the unsanitary manner in which such operations are conducted. There are exceptions, of course, such as the municipal piggery at Flint, Mich., described last week, but by and large the scheme is obnoxious and a public nuisance. Because garbage disposal is inevitably subordinated to hog-raising, the results are incompatible with proper disposal practice. This is especially true where private contractors handle the work, but most municipal operations too are grossly mismanaged.

Hog-feeding is not a complete method of disposal—uneaten garbage, manure and bedding aggregate in weight about 1/3 to ½ of the weight of raw garbage. And this residue is far more offensive than the original. In order to maintain the basic elements of sanitation, therefore, the piggery must be provided with adequate facilities for efficient secondary disposal. Thus the problem goes back to where it started.

Another argument against the method is the knowledge that the spread of human trichinosis is in part traceable to garbage-fed swine. This disease, often fatal, is transmitted by improperly-cooked pork containing the parasitic worm *trichina;* it is stated on reliable authority that probably 1 person in 10 is infected. Dr. M. C. Hall, zoology chief of the Public Health Service, indicts customary garbage feeding as "dangerous to the health of man and livestock", and he reports that centers of high trichinosis incidence are related to places where garbage-fed hogs are eaten.

Evidence of this kind, coupled with the many admitted weaknesses of the scheme, lends support to the desirability or, better, the necessity of revising municipal waste disposal practices in accordance with present-day technical developments.

For Safer Building

ADOPTION of the New York City building code act brings to an end what has at times seemed to be an endless task. Virtually completed in 1932, after four years of hard and effective work on the part of a committee of 125 engineers and architects, the code has since been going through the political mill.

The existing New York code, adopted more than two decades ago, has been the unofficial model of most building codes in this country. The new code will probably not be so potent an influence, since scores of cities have modernized their codes during the past five years. In one respect, however, the New York code goes beyond other codes and invites wide imitation. This is in its requirement that all plans must be signed by a licensed engineer and architect and that an affidavit attesting to the fact that construction has actually followed the approved plans must be filed with the Building Department upon completion of the work.

The aid to safety inherent in this provision is so tremendous that it is by all odds the most important provision of the code. Had it been in effect two years ago, seventeen workmen killed in a Bronx apartment house collapse would in all probability still be alive.

In sanctioning welding, new fire resistive materials, higher unit stresses, more scientific wind force design, smaller live loads, thinner walls, the code follows modern dictates. It was achieved the hard way, namely by complete rewriting instead of by orderly and progressive amendment, but now that it is a fact it brings to a population of 7,000,000 people the benefits that they have a right to expect. The new building code of New York City, like the old one in its day, is worthy to serve as a model for other cities seeking safer and more economical building.

PICTURES IN THE NEWS

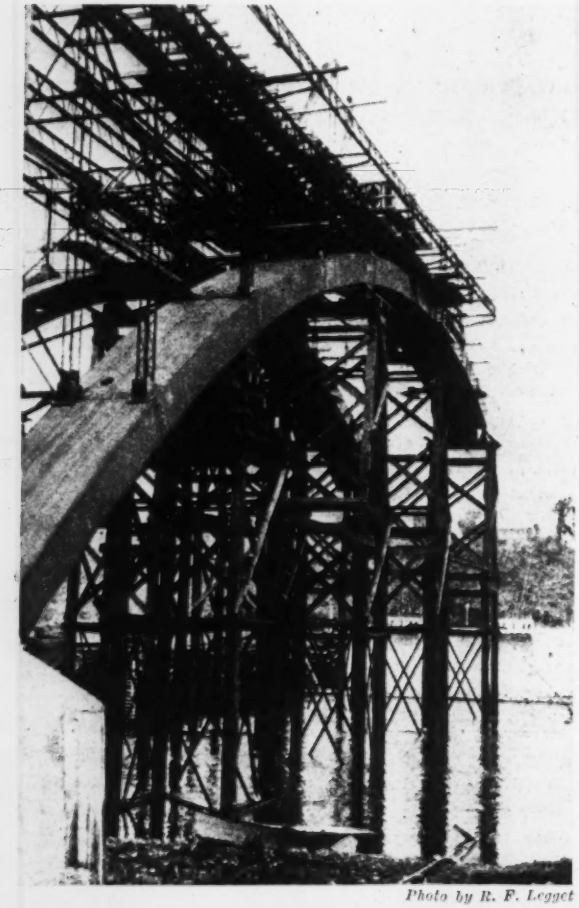

Photo by R. F. Legget

AN UNUSUAL *arch bridge, known as the Pius IX Bridge, is under construction across Back River at Montreal. Hollow steel ribs of spans ranging from 264 to 324 ft. carry reinforced concrete columns supporting a deck of reinforced concrete.*

MORE WATER *for Manila, P.I., is to be provided by the Ipo Dam, now being built by the Sta. Clara Lumber Co. for the Metropolitan Water District. An interesting detail is the use of a concrete wall for the cofferdam in the right foreground.*

Photo by Luis T. Reisse

FIG. 1. THE OLD SOUTH PENN RAILWAY GRADERS MADE GOOD FILLS AS THIS FIFTY-YEAR OLD EMBANKMENT SHOWS.

Road Transport Resurrects a Railway

Old grade and tunnels of the South Penn R. R. partly completed half a century ago will be converted into an express highway 164 mi. long to cost $60,000,000

HALF A CENTURY has seen a new generation grow up and forget the "South Penn" railroad—one of the boldest pieces of engineering and the cause of one of the fiercest battles of financiers that signalized the storm period of railway competition. Now a new form of transport plans to resurrect the work of the engineers and by spending $60,000,000 to capitalize on the $10,000,000 investment in grading and tunneling made by them. The sponsors of this new enterprise, the Pennsylvania Turnpike Commission, have a real plan in development for an express highway of magnificent proportions and have assurance that money for carrying it out can be secured.

A ten-million-dollar railway grade that William H. Vanderbilt used as a bludgeon to drive the Morgan interests from his railroad preserves along the Hudson River has lain for fifty years among the mountains and valleys of southern Pennsylvania, overgrown with brush and all but forgotten. It is now to be resurrected and used in a fight against the highway hazards of the Alleghenies, bringing realization to a century-old dream. The tunnels and roadbed constructed by Vanderbilt as a threat to the growing strength of the Pennsylvania R.R. will never feel the pounding of locomotives on steel rails, but they will provide the way for a new concrete superhighway over which trucks and automobiles will travel in a stream to dwarf the imagination of the early builders.

Struggle to live

A hundred years ago surveyors were sent out by the state of Pennsylvania to trace the path of a new railroad from Chambersburg in the Cumberland Valley to Pittsburgh, 125 mi. to the west. As the survey progressed it became apparent that the mountain grades encountered and the tunnels required to avoid impossible ascents placed the project beyond the realm of immediate possibility, even with subsidies from the state. Work was abandoned for seven years before the state initiated a second survey, which proved as abortive as the first.

Ten years later, in 1854, private interests obtained a charter for the Duncannon, Landisburg & Broad Top R.R. and made a new survey. In the succeeding decade the management seemed to be in the hands of lawyers rather than engineers, for the net accomplishment was to change the name of the embryo line successively to Sherman's Valley & Broad Top, Pennsylvania & Pacific, Harrisburg & Western and finally in 1863 to the Southern Pennsylvania railroad. Nearly twenty more years passed during which the charter was kept alive and the new road lay dormant, until the whole scheme became a pawn in the greater game

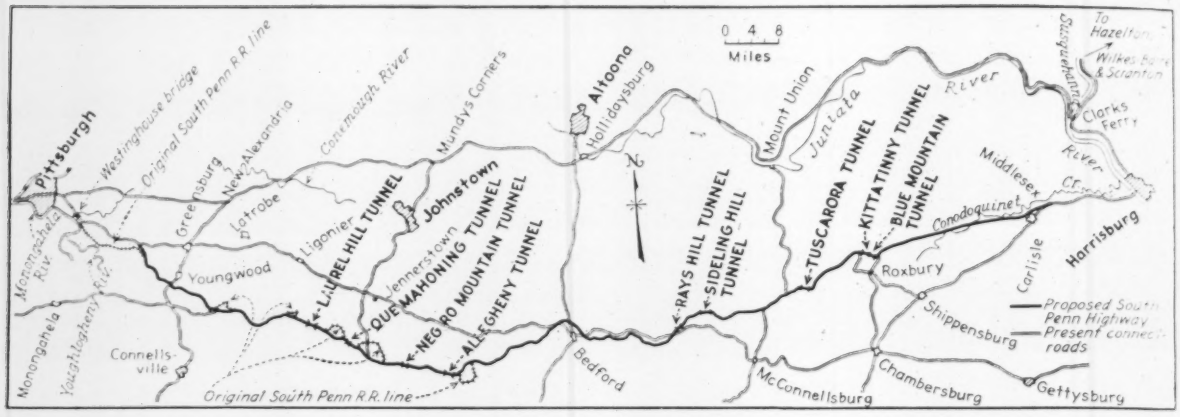

Fig. 2. Location of new South Penn highway in relation to the two present highway routes across the Allegheny mountains to Pittsburgh.

between the railroad giants of the early eighties.

Revived for war

The invasion of the Hudson River valley by the Morgan-controlled Pennsylvania R.R. was the signal for a war. The Pennsylvania's purchase of the West Shore line was a threat to the monopoly exercised by the New York Central and Vanderbilt did not long leave the challenge unanswered. The third of a million dollars which the state and the five successive private companies had expended on preliminary surveys for a South Pennsylvania line suddenly paled into insignificance in comparison with the millions which Vanderbilt flung into the battle.

In 1881, three hundred men began a survey in which 5,000 mi. of location lines sought out and established the final route of 203 miles. Thousands of laborers followed, to live in mushroom villages along the route, drive tunnels through the mountains, fill in the gullies, build great limestone piers for bridges and make good Vanderbilt's threat to open up and control the development of the rich southern counties of Pennsylvania. So rapidly did the work progress that by November, 1885, nearly 4½ mi. of tunnels had been driven and more than 5,000,000 cu. yd. of grading had been accomplished. Crude wooden forerunners of the power shovel speeded up the excavation and hopes were high that the road would be completed by the following summer.

But the ten million dollars expended were not for the purpose of opening up the rich coal regions of the southern tier of counties nor for the promotion of prosperity. The 27 men who lost their lives in the ruthless attack on the mountains were not fighting for man against nature. They died in a battle for supremacy between two great financial groups for the right to the exclusive enjoyment of all the traffic would bear. When a truce was signed in Wall Street and Vanderbilt was left in undisputed possession of the Hudson River, the construction camps were closed, men were fired over night and the silence of desolation fell upon the Pennsylvania battlefield. Invested at 3½ per cent, the ten millions spent on the battle would today be worth sixty millions, more than the estimated cost of a superhighway on the railroad location.

But a vast amount of construction had been done. An editor of *Engineering News* who traveled by team and on foot the 200 mi. of grade when construction was at its peak told the story in the issue of that journal for Oct. 4, 1884. It is a narrative of bold engineering and unbounded construction efforts, of names that rank high in the history of American railways.

Resurrection undertaken

Fifty years after the debacle of the South Pennsylvania, public interest in the possibilities of a modern highway along the route of the old railroad site had reached such proportions that the Pennsylvania state highway department was authorized by the legislature to cooperate with the Works Progress Administration in making a survey of the old roadbed and a study of the possibilities of utilizing it in the construction of a new highway.

In January 1936, the survey was initiated with the help of a grant from the Works Progress Administration and since that time between forty and seventy WPA workers have been on the job. Winter weather and floods hampered the work but the preliminary survey is practically complete. Since no authentic plans and records were available, it was necessary to trace the old road bed on the ground and transfer the data to U. S. Geological Survey maps before the real survey could be begun. In carrying out the survey, the line was divided into 10-mi. sections to each of which a survey party of five to seven men was assigned.

The mapping work not only reestablished the old course of the railroad, but explored every possibility of improving the route. About 97 mi. of alternate lines were run and in many places it was found possible to shorten materially the old line by effecting changes in grade or alignment. (See Fig. 2). Such departures from the rigid requirements of railroad construction are planned only in cases where they do not involve curves and grades which exceed the best modern practice in highway construction. Intersecting roads, streams and railroads were surveyed for 1,000 ft. or more in each direction from the old line to establish the most favorable points for crossings. Cross-sections were taken every 100 ft. and at intermediate points where the computation of fill made them necessary. Levels were run the entire

length of the line and benchmarks were established on U. S. Coast and Geodetic Survey data.

The WPA is following up the preliminary survey by more detailed work involving the drainage, investigation and measurement of the tunnels and an extension of the cross-section work necessary for accurate planning and computation of the grading. The possibilities revealed by the survey are so promising that plans are being established for the actual construction of the new highway. On May 21, 1937, Governor Earle of Pennsylvania signed an act of the legislature creating the Pennsylvania Turnpike Commission and authorizing the issue of revenue bonds to raise the necessary funds for the construction and initial operation of the turnpike on the route that has been located.

Plans for the super-highway provide that beginning at a point on the Lincoln Highway 20 miles east of Pittsburgh, two ribbons of concrete separated by a planted center strip will stretch for 164 mi. through the Alleghenies and across the Cumberland Valley to a point about 15 mi. west of Harrisburg. A 22-ft. width of pavement will afford ample safety for two traffic lanes in each direction, protected from traffic in the opposite direction by the 6-ft. width of the dividing strip.

The rigid restrictions of grade and alignment imposed by railroad practice on the original location render it possible to keep the maximum grade to 3 per cent, as contrasted with the long stretches of 8 and 9 per cent grades on the present routes through the Alleghenies. Instead of the sharp curves of the existing roads, curves on the new highway will be limited to 6 deg. Three-quarters of the route is straight and one section extends for 40 mi. without a curve. Safety in winter weather will be further promoted by the original effort of the railway engineers to utilize as much as possible the west and south slopes of the mountains to afford the maximum possible exposure to the sun to accelerate the melting of snow and ice. Nine tunnels which are now more

Fig. 3. Inside one of the old tunnels (Blue Mountain) on the South Penn railroad showing condition after fifty years.

Fig. 4. Approach cuts to the South Penn. tunnels have in half a century grown up to woods but the work of the old earth movers is still plainly visible.

than half completed promise the motorist protection from the hazardous slopes of the highest peaks.

What the reduction in grade and the use of the tunnels will mean to trucks can best be visualized by the difference in the climb required on the Lincoln Highway and the new road. The present route from Harrisburg to Pittsburgh has grades which necessitate a total cumulative climb of 13,330 ft.; the new highway will involve a cumulative climb of only 3,940 ft., a reduction of more than 70 per cent. The cost of operating trucks increases very rapidly when the grade exceeds 3 per cent, being about twice as great for a 9 per cent grade as for one of 3 per cent. For passenger cars the difference is less apparent, but all who use the road will benefit from the greater safety of the reduced grades and improved alignment, as well as from the saving in time resulting from the greater speed that can be safely maintained on this type of highway.

In keeping with modern practice on superhighways the new road is planned to bypass all towns and cities along the line and effect a grade separation at intersections with railroads and other highways. Ramps will be constructed to reach or leave the highway where it meets feeder roads. To make the route a truly all-weather road, the location lines are being run above the high water mark established by the 1936 floods.

Heavy work necessary

In constructing the highway, full use can be made of the work accomplished by Vanderbilt's engineers. About 15,000 ft. of the tunnel excavation completed by them are sufficient in section for a two-lane highway and the necessary drainage structures. The remaining 8,000 ft. of existing tunnels must be enlarged and 11,000 ft. of new tunnels must be driven. The grading completed for the old railroad bed must be supplemented by additional work in excess of 9,000,000 cu. yd. to provide the necessary width and to carry out the relocations. These tasks, combined with the erection of bridges, the separation of grades at intersections and the construction of the pavement itself, are estimated to give a year's employment to about 19,000 men at different points along the route. To furnish almost 2,000,000 tons of stone and sand, 50,000 tons of steel and 400,000 tons of cement it is estimated that another 32,000 men will be given a year's employment at quarries, mills and other points behind the lines.

Future of promise

Until the detailed surveys and plans are completed the cost of this great undertaking cannot be accurately computed. Preliminary estimates indicate an expenditure between fifty and sixty million dollars or about a third of a million dollars per mile. This sum is comparable with the total annual budget of the Pennsylvania state highway department and is obviously far too great to be financed from current revenues. The liquidation from current revenues of a long term bond issue would necessitate an increase in taxes and create controversy over the equity of placing upon all motorists a burden not proportioned to the benefits afforded in different parts of the state. In the act which created the turnpike commission and authorized the issue of bonds to cover the cost of the proposed highway, the legislature expressly stipulated that "turnpike revenue bonds issued under the provisions of this act shall not be deemed to be a debt of the commonwealth or a pledge of the faith and credit of the commonwealth but such bonds shall be payable exclusively from the fund herein provided therefor from tolls."

The saving in cost of operating trucks and other motor vehicles which the new road will bring about more than counterbalances any toll which it may be necessary to charge. For trucks, a saving of 5 to 6 hr. in the run between Pittsburgh and Philadelphia is enough in itself to warrant the payment of a toll; for other motorists the reduction in hazards and increase in speed will attract even those to whom the economy alone might not be an incentive. In the report of the joint legislative committee, which preceded the passage of the act, it was estimated that the minimum daily average number of vehicles to use the turnpike would be 5,000, which would render it possible to amortize the cost of the road with a very reasonable charge.

The purchase of the bonds has been assured by several investment houses and with the cooperation of the WPA the detailed survey of the route is nearing completion. Construction work may soon be under way to bring about through the joint efforts of government and private capital the realization of a century old dream.

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Boulder Dam Earthquakes Continue

EARTHQUAKES at Boulder Dam continued through the first half of 1937 and, although no serious damage resulted, the frequency of the shocks now occurring where none were reported before the dam was built has given rise to much speculation as to whether the cause lies in the new load placed on the earth's crust by Lake Mead. A significant point is that two residents who have lived in the vicinity for 15 and 17 years report never having experienced an earthquake prior to completion of Boulder Dam.

The U. S. Coast and Geodetic Survey now has three 12-in. accelerographs in or near Boulder Dam; their first records were made April 27, 1937. Prior to that date intensities were estimated. Between Sept. 7, 1936 and July 1, 1937, 49 earthquakes were reported or recorded. These shocks, with ratings of intensity made by Survey officials according to the modified Mercalli scale, are listed in the accompanying table.

It is proposed to make two more instrument installations, one on either side of Lake Mead, in order to obtain further information on the origin of the shocks.

EARTHQUAKE SHOCKS AT BOULDER DAM SINCE LAST SEPTEMBER

Month	2	3	4	5	Total number of shocks
(Column heads indicate intensities on modified Mercalli scale)					
September, 1936	1	5	..	..	6
October	..	..	..	..	..
November	1	..	..	..	1
December	2	..	..	2	4
January, 1937	5	1	..	..	6
February	3	..	..	..	3
March	2	..	..	..	2
April *	9	6	3	..	18
May	..	1	1	..	2
June	..	7	..	..	7
Total number of shocks	23	20	4	2	49

* (Accelerographs installed April 27, 1937)

Tobacco Factory Design

Special requirements met in a new multi-story building for the Imperial Tobacco Co. at Montreal

MODERN TRENDS in the design of industrial buildings are reflected in a new extension to the large manufacturing plant of the Imperial Tobacco Co., Ltd., of Canada, at St. Henri, an industrial part of the city of Montreal. Of reinforced concrete construction, designed for heavy live loads and air conditioned, the new building also marks the first large-scale use of glass block walls in Canada. The estimated cost of the extension—a 5 story structure 63x211 ft. in plan—is about $1,250,000.

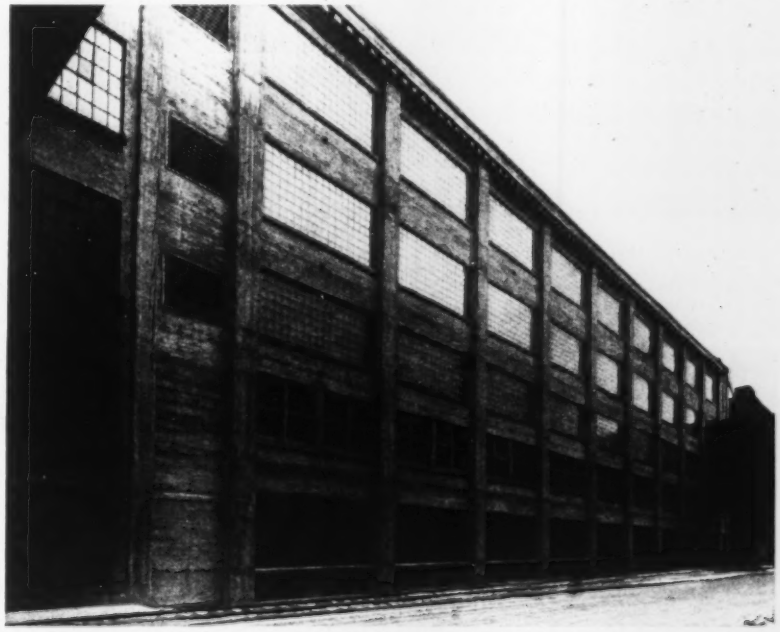
Located on a relatively narrow street, in an area confined on all sides, the new building is to be used for light manufacturing operations in connection with the extensive tobacco business of the owners. A desire to provide satisfactory working conditions for employees, while insuring accurate control of air temperatures and humidity (essential for the manufacturing processes which are to be housed) led to consideration of the use of glass block construction coupled with complete air conditioning. Eventually, it was decided to utilize this type of construction for the top three stories and plans were prepared on this basis by the company's engineer, N. C. Cameron, and his staff. The contract was awarded to the Anglin Norcross Corp. Ltd., Montreal.

Concrete structure

The reinforced concrete frame utilizes flat-slab, drop-panel construction, with circular columns, spaced at 21 ft. centers, and spirally reinforced. The live loading used for all floors is 250 lb. per sq.ft., this being adopted to take care of the varying manufacturing demands. The flat roof slab is 6½ in. minimum thickness, finished with a 20-yr bonded asphalt roof surface. The whole of each floor is clear of obstructions, apart from columns, all services being located at one end of the building together with stairways, elevator and air conditioning equipment. One side of the ground floor is of special design, to provide a covered loading platform serving rail tracks alongside, the platform being arranged as a covered recess, 10 ft. wide, in from the face of the building, and 10 ft. high.

Glass block walls

The design adopted resulted in 8x18-ft. wall openings in the upper floors, and to fill these, 12x12 in. glass blocks, 4 in. thick, were used.



Outside evidence of inside air conditioning in the top three floors of this tobacco factory is given by lowered air intakes and the windowless glass block walls.

In laying the blocks 1¾-in. galvanized flats of 20-gage metal, with 1-in. holes punched at 3-ft. centers, were used as reinforcement, supplemented by 3/16-in. steel pencils at every course horizontally. A 2-in. anchorage was used at all jambs. Joints were made 5/16-in. thick vertically, and ¼-in. horizontally, but experience showed that 3/16-in. joints in both directions would have been preferable. Several mixtures were tried as jointing material, but that finally adopted as most satisfactory was a mortar made up of ordinary portland cement and fine sand, a small amount of lime putty being added to make it easy running. A clearance of ⅜-in. was left at jambs and lintels, and this was filled with mastic, being finally calked with a mastic gun.

Windows are used in the two lower floors, since they are not air conditioned. However, these windows are of special type in which the timber frames are rabitted out to provide for the attachment of a second metal inner frame and glass, this giving the effect of an insulating body of air between the two panes, and preventing condensation from the humid working atmosphere.

The exterior finish of the buildings is plain concrete, but as vibrators were used in placing, this is very satisfactory. The standard practice of the company for interior finish is to paint directly onto the concrete, using first a special priming coat to neutralize all free lime.

Special attention has been given to floor finish, the company having experimented with many different types, including special floor hard-

eners in concrete, asphalt floor finishes, etc. For the new building, the results of this experimentation are being applied by the adoption of a special hardwood floor. Spruce boards $\frac{7}{8}$ in. thick are first laid diagonally on 2x4-in. sleepers at 16-in. centers, secured to galvanized clips laid in the concrete. On this base, special birch tongued-and-grooved boards, 1-5/16-in. thick, with 3¼-in. faces, are laid. This unusual thickness of hardwood is necessary to give a floor rigid enough to withstand the vibration set up by the machinery used in manufacturing, which is found to break off the tongues of thinner boarding. This type of floor is now used generally in the company's plant.

Air conditioning layout

Manufacturing requirements demand a constant temperature of 70 deg. at 70 per cent relative humidity. After much study, this is being attained by separate installations for each of the three top floors, each floor being equipped with a combination heating, humidifying and ventilating unit, electrically driven and operated, supplying a complete air change for each floor every 10 minutes. The unit is located at one end of the floor, and from it lead light metal ducts for air discharge and return. These ducts, which are supported by clamps from the ceiling, run along the two main walls of the building. The duct for air discharge is taken from the unit to the opposite side of the building while the return duct leads straight to the unit. This duct arrangement is designed to give a cross circulation of air all along the floor, the drops from the two ducts being so arranged that air currents are properly directed with respect to personnel and equipment. Control of the units is automatic.

Plastic Flow in Concrete

by R. E. Davis, H. E. Davis and E. H. Brown

University of California, Berkeley, Calif.

Abstract of an A.S.T.M. convention paper that evaluates existing knowledge of plastic flow effects in terms of design and construction practice

In the technical literature of a decade ago, there was frequent reference to the strength and elasticity of concrete but only occasional mention of shrinkage due to drying and almost no suggestion of that property possessed by all concrete of a gradually increasing deformation under the action of sustained load, which has been variously called "creep," "time yield," and "plastic flow."

As a result of the research of recent years there has been developed a general conception of the effect of shrinkage and plastic flow upon the behavior of concrete structures, which is already leading to marked changes in design and construction practices. These changes perhaps mark a new era of development in the art and science of concrete construction.

It is now generally believed that shrinkage and plastic flow are closely related phenomena, each being primarily due to changes in the amount of adsorbed water in the cement gel and being but little directly influenced by the free water occupying the pore spaces within the concrete mass.

In spite of the rather extensive researches that have been made in this field, it is not yet possible quantitatively to state with any degree of certainty what is likely to be the magnitude of either plastic flow or shrinkage under the conditions which surround any given concrete structure, nor is it possible quantitatively to state with accuracy what is the effect of plastic flow and shrinkage upon the magnitude and distribution of stresses.

Although shrinkage is an altogether undesirable property and one which probably can never be entirely eliminated, there is a possibility that, through the proper selection of materials and methods, it can be reduced to a point where it will not be a factor for serious consideration—certainly to a point far below that observed in present-day concretes. In contrast, plastic flow does not seem to be an undesirable property. In certain reinforced concrete members it tends to make possible more efficient use of steel, and in thin structures subjected to drying, as well as in mass structures subjected to thermal changes due to the hydration of cement, it tends to promote a more favorable distribution of stresses than would otherwise exist.

The purpose of this paper is to present the results of some of the investigations made at the University of California, all having to do with volume changes of concrete, and to point out the possible significance to design and construction problems of volume changes under the action of sustained load, referred to as plastic flow.

Scope of investigation

Started in 1926, plastic flow investigations at the University of California, have comprised to date some 25 series of tests. Among the earlier series were included studies to determine the effect upon plastic flow under sustained compressive stress of (1) duration of loading, (2) moisture and temperature conditions of storage, (3) moisture content of concrete, (4) gradation and mineral character of the aggregate, (5) size of mass, (6) age at time of load application, (7) intensity of sustained stress, and (8) reinforcement.

Recent series of tests, undertaken during the period 1934 to 1937, have included studies to determine (1) the effect of water-cement ratio and aggregate-cement ratio upon plastic flow, (2) the effect of fineness and composition of cement upon plastic flow, (3) the plastic flow of concretes in tension and in compression, (4) the fiber strains in plain concrete beams under constant sustained bend-

ing moment, and (5) the stresses developed in large concrete cylinders under complete axial restraint during a heating-cooling cycle similar to that which will occur in mass concrete.

Long time stress changes

Observations of plain concrete cylinders which have been under various intensities of sustained compressive stress for a period of 10 yr. indicate that the plastic flow is still increasing at a measurable rate. In the extreme case of a sustained stress of 900 lb. per sq. in., the total flow of air-stored specimens for the 10-year period has amounted to more than 1.3 in. per 100 ft. The total flow of water-stored specimens is of the order of ⅓ to ½ of that of air-stored specimens, but at the later ages it is observed that the rate of flow is greater for the water-stored specimens than for the air-stored specimens.

In a series of tests on reinforced concrete columns which have now been under load for a period of 5½ yr., the stress in the steel is still increasing and the stress in the concrete is still decreasing. For dry-air storage for columns carrying a large percentage of reinforcement, due to the combined effect of shrinkage and flow the concrete is actually in tension, and all of the load is carried by the steel. For dry-air storage and for columns carrying a small percentage of reinforcement, the stress in the steel during the loading period has increased from 8000 to 42,000 lb. per sq. in., while the stress in the concrete has decreased from 1000 to 300 lb. per sq. in.

At the end of 5½ yr., the stress in the steel for columns stored in dry air is three or four times that of corresponding columns stored under water.

A/C and W/C

Evaluation of the effects of variations in the aggregate-cement ratio and in the water-cement ratio upon plastic flow has frequently been complicated by the fact that these ratios have been varied simultaneously. In order directly to determine the effects of these factors, a series of tests was undertaken in which, for concretes of each of three different cement contents, two different water-cement ratios were employed. The tests were carried out in air at 50 per cent relative humidity and 70 deg. F.

The effect of water-cement ratio upon plastic flow is marked. The results of these tests up to the age of about two years show that between two concretes of equal cement content, the one having the higher water-cement ratio exhibits the largest flow. For example the flow for a water-cement ratio of 0.7 was 50 per cent greater than for a water-cement ratio of 0.6. For concretes having the same water-cement ratio, the richer mixes exhibit more flow than the leaner mixes, and the magnitude of the flow is directly proportional to the cement content.

It seems reasonable to suppose that within ordinary limits the water-cement ratio has no marked effect upon the amount of the water of adsorption, but that a higher water-cement ratio, through increasing the size of the pores between the cement grains, produces a paste structure from which the free water may more readily escape, and hence, under conditions of stress, the more readily may the water of adsorption be given up. Also it appears reasonable to suppose that the more open the pore structure, the less will be the areas of contact between neighboring hydrated cement grains, and hence under a given load the higher will be the stresses over such areas of contact. There appears the interesting possibility that the particle-size distribution of a cement, through its effect upon the structure of the hardened cement paste, may have an important influence upon the rate and magnitude of volume changes in general.

Tension vs. compression

It has frequently been assumed that flow of concrete in tension is approximately the same as the flow in compression. The results of two series of tests indicate that this is not true, and definitely show that, for certain cements including low-heat and normal portlands, the flow in tension is considerably greater than that in compression, at least up to the age of 6 months. It has been observed, however, that after a few weeks under load the rate of tensile flow may be less than the rate of compressive flow. This points to the possibility that flow in compression may in time equal or exceed that in tension.

Stress-strain data from rapid-load tests also exhibit the same trend, that is, a considerably larger tensile unit deformation than compressive unit deformation for the same unit stress.

While this property of flowing more in tension than compression may not be characteristic of all concretes, it obviously is a desirable property since it tends to reduce cracking either due to drying or to thermal changes. It perhaps partly explains the absence of cracks and checks in thin structures subjected to drying which were made with cements exhibiting above-normal unrestrained shrinkage. It perhaps explains why mass structures made with slow-hardening cements exhibit so few cracks as compared with corresponding structures in which more rapid hardening cements have been employed.

In a series of tests on plain concrete beams under moist air storage conditions, it has been observed that the plastic flow of fibers on the tension side of the beam are greater than corresponding flow on the compression side. In parallel tests on plain concrete beams stored in dry air, at the age of 6 weeks it was observed that the plastic flow of the extreme compression fiber was three times as great, and of the extreme tension fiber 10 times as great as corresponding flow observed on beams stored in moist air. For dry-air storage the modulus of rupture at the end of the test period was only half as great for beams subjected to sustained moment as for corresponding beams which had not been stressed.

The results of the two groups of tests just described demonstrate the very marked effect of the humidity of the surrounding air upon both the plastic flow and the modulus of rupture of concrete subjected to sustained bending moment. Obviously, whether the structural element be plain or reinforced, it is desirable that the concrete of which it is composed be of a quality which under drying conditions will exhibit maximum flexural strength under sustained moment. In other words, it is desirable that the concrete be one in which the effects of plastic flow and shrinkage due to drying, one tending to offset the other, would combine to produce the most favorable distribution of stresses.

Effect of cement

The results of observations of plastic flow of mass-cured concretes made with a normal portland and a low-heat portland, each ground to the

same surface area, show a marked effect of composition of cement upon plastic flow in compression. Up to 4 months, the flow of the low-heat portland is approximately double that of the normal portland. In a further series of tests undertaken to study the effect of fineness of cement upon flow it has been observed that concrete containing coarsely ground low-heat portland cement exhibited much the largest plastic flow at all ages.

Crack formation

Certain European experience has pointed to the desirability of employing relatively coarse low-heat cements for mass structures in order to reduce cracking to a minimum. The Crystal Springs Dam, south of San Francisco, built nearly fifty years ago with a coarse cement of composition quite similar to that of our modern low-heat cements, is perhaps one of the finest examples of our older structures located in a comparatively dry climate that has developed almost no cracks nor surface checks. The same general freedom from cracks is also observed in the recently constructed Morris Dam where the modern type of low-heat cement was employed for the first time in this country. On the other hand, where modern, more rapid-hardening portland cements of normal or modified composition and comparatively high fineness have been employed, mass structures have shown frequent cracks of considerable magnitude. It is believed that this difference in degree of cracking under field conditions can be accounted for in no other way than through differences in the plastic flow characteristics of the concretes of which the structures are composed, a plastic flow primarily due to differences in composition of the cements.

Stresses from thermal changes

In tests using cements having a wide range in specific surface the flow decreases in some cases and increases in others as the specific surface increases. The reason for these peculiarities is not evident, but it seems possible that it may be due to variations in the particle size distribution of the cements, which are not manifest in the calculated value of the specific surface, and it seems possible that the particle-size distribution of a cement may exert marked influence upon the flow characteristics of concrete.

In an attempt to determine the stresses which may be developed in concrete under temperature conditions similar to those occurring in mass concrete, tests were made upon 12 x 48-in. concrete cylinders which were maintained at constant length during a temperature cycle of approximately that which has been observed as the mass heats and cools, with a temperature varying from 60 to 94 deg. F. Under these conditions of complete restraint, the compressive stress reached a maximum of 125 lb. per sq. in. at the age of three days. When the temperature had reached a maximum at the age of 25 days, the compressive stress had decreased to 110 lb. per sq. in. At the age of 40 days, when the temperature had declined only 5 deg. F. from the maximum, the compressive stress in the restrained specimen had declined to zero. At the age of 80 days, when the temperature was still 20 deg. F. above the initial temperature, the tensile stress in the concrete had increased to 200 lb. per sq. in.

Applying the data

While no concrete structure is completely restrained and therefore the thermal stresses developed during the course of the experiment just described were in excess of those which would actually be set up in a structure built of the given concrete and subjected to the given temperature changes, yet in the cases of thick walls, heavy foundation, bridge piers, and dams resting on rock foundations, the conditions of the experiment may be approached. For this reason the results are of value as indicating in many mass structures the existence of high stresses due to heating and cooling, not only in the vicinity of the foundation rock but at exposed faces, keyways, and along construction-joint planes between lifts. In certain types of structures residual stresses due to thermal changes may not be a matter of importance. In the case of dams, however, these stresses, in combination with those due to load, may produce a stress system far different from that calculated by the usual methods of analysis which entirely ignores the effects of thermal changes. The condition of dams, where there are in evidence many structural cracks in spite of contraction joints, makes it appear that this must be true.

The results are also of value in showing the large part that plastic flow plays in the development of stress during the heating-cooling cycle, and in indicating a method which may be employed in experimentally determining the magnitudes of thermal stresses that are likely to occur in any proposed structure. When through the results of extensive experiment there have been established the time-flow-stress-temperature-restraint relationships for a wide variety of conditions, they may be employed in a rational method of thermal stress analysis. This appears to be the next step—a step which will remove an important element of uncertainty which now exists.

• • •

Building Construction Boom Sets Record in South Africa

An all-time record for applications to erect new buildings in Johannesburg was established during February of the current year, thereby causing a continuation of the building boom which is stated to have prevailed in South Africa for some months past, according to the Bureau of Foreign and Domestic Commerce.

During 1936 the value of plans accepted for construction in the South African Union is reported to have registered an increase of 36 per cent over the 1935 value and 62 per cent over 1934. Most of the construction is in Johannesburg, but moderate increases are also evident in Capetown, Durban, and Pretoria.

The construction consists largely of government buildings and apartment houses and also involves a slum clearance program.

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Montana Bituminous Meeting

The third annual Montana Bituminous Conference will be held Sept. 7, 8 and 9 at the Many Glacier Hotel in Glacier National Park. All of the states, the provinces in Canada, several departments in Mexico, leading industries and interested colleges and universities have been asked to prepare papers outlining their developments, or trends in bituminous practice.

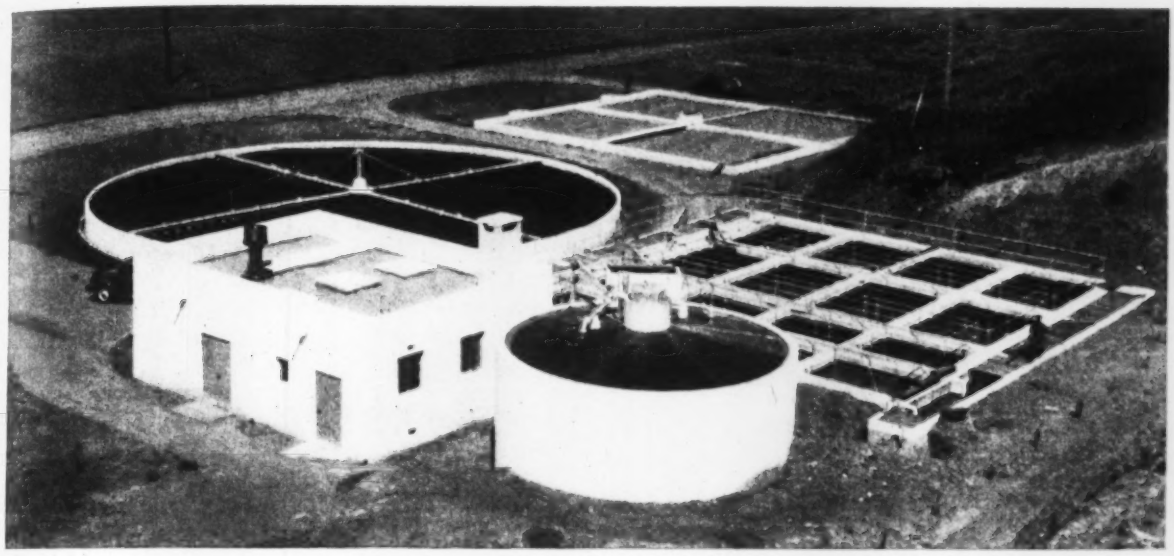

FIG. 1. BIO-FILTRATION SEWAGE TREATMENT PLANT AT CAMARILLO STATE HOSPITAL, CALIF.

Bio-Filtration at Camarillo, Calif.

by HARRY N. JENKS

Consulting Sanitary Engineer, Berkeley, Calif.

Design and functional characteristics of a novel single-stage bio-filter installation for the complete treatment of strong institutional sewage

Recirculation of sewage through a rock filter at high rates of flow is termed "bio-filtration" by the author, who developed the process. This principle of accelerating biologic oxidation appears to combine in a single form of treatment the advantages of the activated sludge process and those of the trickling filter. The plant described below is the first installation to be made based on the author's experimental and semi-plant studies described in ENR May 21, 1936, p. 721. — EDITOR

RECENTLY PLACED into operation at the Camarillo State Hospital, Calif., is a 1 m.g.d. sewage disposal plant employing the bio-filtration process for treatment. The new plant consists essentially of primary sedimentation units, a coarse rock filter through which sewage is recirculated at high rates of flow, detention-settling tanks and separate sludge digestion facilities. Purified effluent is used for irrigation purposes on the hospital grounds which occupy 1,700 acres on a site 60 miles north of Los Angeles.

In planning the sewage disposal facilities to care for an initial population of 2,500 mental patients and an ultimate population of 6,000, together with 1,000 employees, it was necessary to provide not only for the treatment of the domestic sewage, but also for that of a considerable volume of laundry and dairy wastes. Another factor of significance was the mineral content of the water supply, reflected in a total hardness ranging from 400 to 500 p.p.m. A treatment process was required that would be capable of withstanding the unfavorable effects of the widely fluctuating volume and concentration characteristics of an institutional sewage. Of equal importance in relation to the available supervision was the element of reliability in operation, and the readiness with which the plant might be controlled.

A degree of treatment was sought comparable to that obtained with the activated sludge process and which, at the same time, provided the dependability and economy of the trickling filter process. Taking into account the foregoing requirements and correlated considerations of cost, it was evident that bio-filtration would be particularly applicable inasmuch as the design and functional characteristics of bio-filter plants attain the purpose of merging these desirable elements. (*ENR* May 21, 1936, p. 721). Furthermore, in respect to cost, the bio-filter plant is substantially less expensive to build than the trickling filter plant and, likewise, less expensive to operate than an activated sludge plant.

Sequence of treatment

In the Camarillo installation, illustrated in Fig. 1, the preliminary treatment accorded the sewage is, subsequent to screening, one of sedimentation. The raw sludge removed from the primary tanks is then subjected to separate sludge digestion and afterwards dried on sandbeds.

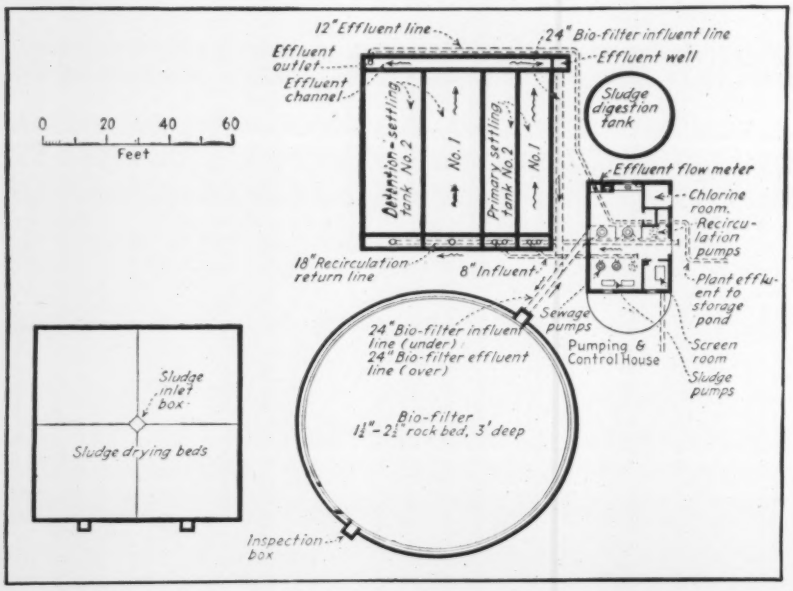

Fig. 2. Units and layout of the 1 m.g.d. treatment plant which is designed for future enlargement.

The clarified effluent flows by gravity to the bio-filter, where together with the flow of recirculation, it is applied to the rock bed by means of a rotary distributor mechanism. Effluent from the bio-filter is returned by pumping units to combined detention-settling tanks. After passing through these, the major part of the liquid flows back to the bio-filter, mixing enroute with the primary settling tank effluent and being diluted thereby. The remainder of the detention tank effluent, in an amount equal to the incoming sewage flow, passes through an effluent controller valve and pipe line to a storage pond.

Sludge originating within the system and removed from the detention tanks is disposed of in the same manner as the raw sludge, or it may be returned to the bio-filter in order to maintain any desired amount of solids concentration in the recirculation system. The detention tank sludge which is comparatively small in amount has good settling characteristics and is readily digested.

The course of the sewage through the plant, and the concomitant flow of recirculation are clearly indicated in Fig. 2 which shows the general layout of the structures and pipework. For reasons of economy, certain elements of the plant, such as the primary settling tanks and the sludge digester, have been designed for the ultimate population of 7,000. It is of interest to note that the process of bio-filtration as embodied in this installation, enables the initial units to be incorporated as the primary units of a future two-stage plant having a capacity of about double that of the initial construction.

Bar screen and pumps

Sewage reaching the plant passes through a screen 2 ft. wide by 1 ft. high with 1-in. clear spaces between bars. The capacity of the cleaning mechanism is 1½ cu. ft. of screenings and 1 cu. ft. of grit per hr. Screenings are disposed of by burial in a nearby pit.

Two vertical, submerged-type, non-clogging sewage and trash pumping units lift the raw sewage from the

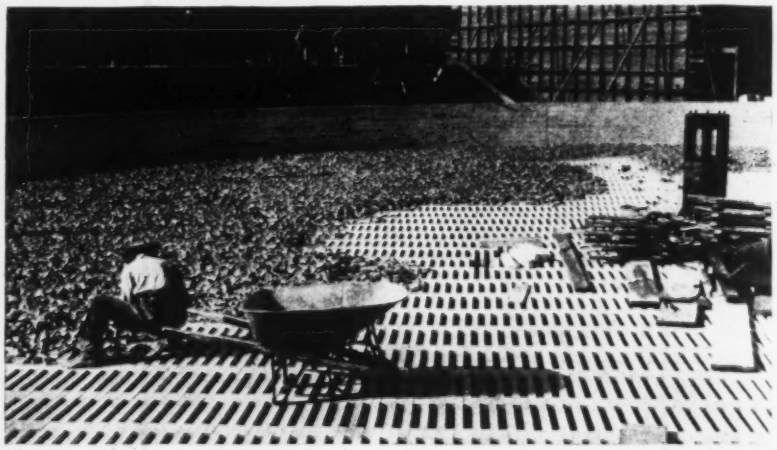

Fig. 3. Underdrain system of the filter bed showing pre-cast concrete grillage and initial layer of hand-placed rock.

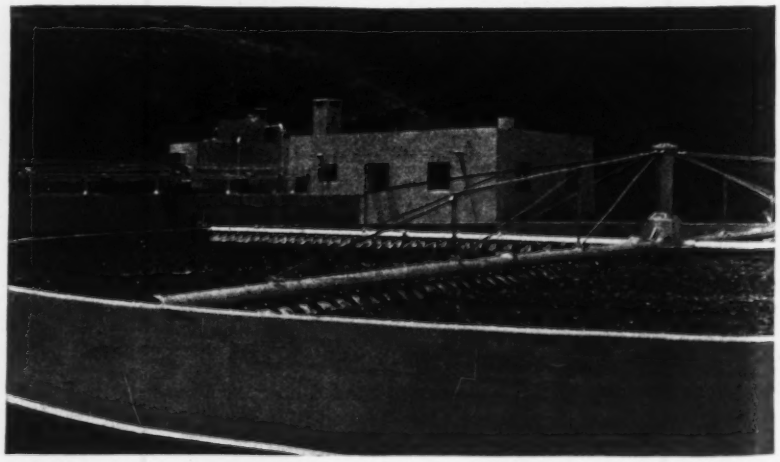

Fig. 4. Rotary sewage distributor in operation on the bio-filter. Capacity of mechanism 3,500 g.p.m. at 24 in. head loss.

bar screen sump-well into the primary tanks. The capacity of each pump is 400 g.p.m., against a total head of 22 ft.

The primary settling tanks are duplicate parallel units each 54 ft. long, 10 ft. wide and 10 ft. in depth. They operate independently of each other and are provided with continuous sludge collector and scum skimming mechanisms. They are designed for ultimate sewage flow reaching the plant.

The actual period of sedimentation is controlled by bypassing a portion of the flow of recirculation through one or both tanks, as indicated in Fig. 2. This split-return of the bio-filter effluent, as between the detention and primary settling tanks, is of advantage from both the biologic and hydraulic viewpoints. It permits (1) pre-seeding of the raw sewage prior to the merging of the primary tank effluent with the flow of recirculation passing forward to the bio-filter; and (2) the operator has at his command a means of maintaining a reasonably constant velocity and period of sedimentation independent of the fluctuations of sewage flow, by admitting more or less of the flow of recirculation with the influent to the primary settling tanks. It is a matter of importance, of course, to avoid over-detention in the settling tank and consequent danger of septicity. In starting up a new plant it is advantageous to have such control over the settling period when otherwise unduly long periods would prevail because of the initial flow being only a fraction of that for which the tank has been designed.

Table I BASIC FLOW DATA USED IN DESIGN

	Initial	Ultimate
Population	2,300	7,000
Per Capita flow	80 g.p.d.	80 g.p.d.
Total daily flow	184,000 gal.	560,000 gal.
Rate of flow (14 hr. period)	0.33 m.g.d.	1.0 m.g.d.

Table II DESIGN CHARACTERISTICS OF DETENTION TANKS

	Initial		One-half Ultimate	
	1 Tank	2 Tanks	1 Tank	2 Tanks
Detention period, hr., on basis of sewage flow	5.3	10.6	3.5	7.0
Settling period, hr., on basis of recirculation rate (*Re*)				
Minimum *Re* (1,200 g.p.m.)	1	2	1	2
Maximum *Re* (3,000 g.p.m.)	0.4	0.8	0.4	0.8
Sedimentation rate, g.p.d. sq. ft. on basis of				
Minimum *Re* (1,200 g.p.m.)	1,780	890	1,780	890
Maximum *Re* (3,000 g.p.m.)	.....	2,220	.....	2,220

Table III FILTRATION RATES ON THE BIO-FILTER BED

	Initial	Ultimate
Rate of filtration (*F*), m.g.a.d.	2.5	8
Rate of recirculation (*Re*), in terms of rate of sewage flow (*Q*)		
Minimum	5.5*Q*	2*Q*
Maximum	14*Q*	4.5*Q*
In terms of application to the bed, m.g.a.d.		
Minimum	14	16
Maximum	35	36

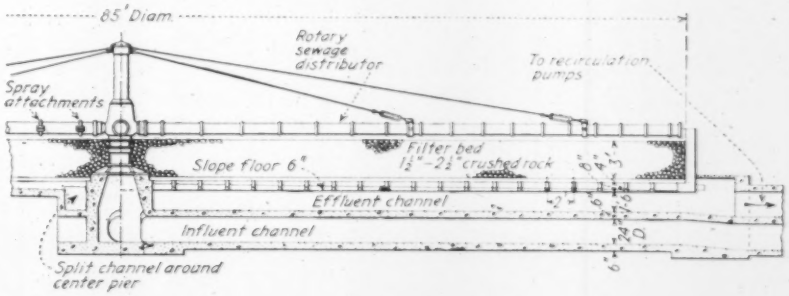

Fig. 5. Design details of the bio-filter. Note the low wall of but 4 ft. 6 in. height, corresponding to the shallow depth of rock bed.

Detention tanks

In a manner similar to the aeration tanks employed in the activated sludge process, the detention tanks of the bio-filter plant serve to hold the flow a sufficient length of time to enable biochemical oxidation to be carried to practical completion. An important distinction, however, between the detention tanks and the aeration tanks of the two types of plants lies in the fact that in the case of bio-filtration, the function of aeration is delegated to the bio-filters which are external to the tanks, and in its place the function of sedimentation is added, in contrast to the use of final settling tanks in the case of treatment by activated sludge.

The period of recirculation, which corresponds to the number of hours of retention of the sewage flow within the plant, is strictly analogous to the period of aeration in the activated sludge plant. In either case, the usual period provided for in practice, for complete treatment, is six hours for sewages of normal strength.

Detention tank capacity was determined on the basis of the required period of recirculation of the sewage flow. The corresponding period of sedimentation within the detention tanks, for any given aggregate tank capacity, depends on the ratio of the rate of recirculation (designated as *Re*) to the rate of sewage flow (designated as *Q*). The accompanying tabulation of data relating to the detention tanks illustrates the foregoing principles of design (Table II).

Experience shows that when the detention period is 4 to 6 hr., a 0.75-hr. period is sufficient for adequate sedimentation, because of the favorable characteristics of the resulting sludge, to which reference has already been made.

In the Camarillo installation duplicate parallel detention-settling tanks are provided, each tank being 54 ft. x 18 ft. wide with 10 ft. depth. The pair of detention tanks provides for single-stage treatment of the one-half ultimate flow, or for the first stage of two-stage treatment of the ultimate flow.

Bio-filter design

By virtue of passing clarified sewage through the filter rock repeatedly rather than once as in the trickling filter, it is possible to work the bio-filter from eight to ten times the rate per cubic yard of filter material than is practicable with the trickling filter. The biologic oxidation of the organic matter in the sewage takes place in the bio-filter bed with secondary reactions occurring also during the passage of the recirculated flow through the detention tanks. Through the return of sludge from these tanks, it is possible to activate the biologic condition of the filter bed when and if required by the volume or concentration of the sewage undergoing treatment.

The bio-filter bed of the Camarillo plant is 85 ft. in diameter, and has a net area of 5,600 sq. ft., equivalent to one-eighth acre. The bed, made up of crushed rock 1½ in.-2½ in. size, is 36 in. deep and was designed for single-stage treatment of the ultimate flow. Owing to the presence of unpredictable amounts of toxic substances and other inhibitory wastes in the sewage, together with the excess amount of sulphates in the water, a factor of safety of at least two has been allowed in the bio-filter area and corresponding rate of filtration as indicated in Table III.

As may be noted from Figs. 3 and 5, several novel features of design characterize the bio-filter structure and equipment. They are: (1) the filter underdrain system; (2) the filter bed enclosure; and (3) the hydraulic conditions embodied in the size of the influent and effluent channels and the capacities of the distributor mechanism and recirculation system.

Underdrain System—The underdrain system, as shown in Fig. 3, comprises a sloping floor provided with concrete joists at 2 ft. centers surmounted by a precast concrete block grillage. This type of construction provides ample drainage and affords the generous amount of space required for adequate bottom ventilation of the bio-filter medium; the latter is necessitated by reason of the extremely rapid biochemical oxidation taking place within the rock bed when operating at high rates of filtration. Ready access of air to the underdrain system is ensured by the provision of 2x6 in. apertures located at the base of the circular bio-filter wall and between each pair of joists.

Filter Depth—One of the distinguishing features of the bio-filter, in contrast to the conventional trickling filter, is its shallow depth. Experimental studies have indicated that a 3-ft. depth is of rather general applicability to the treatment of sewages. In addition to the greatly reduced volume of filter material, the bio-filter design permits economy from the standpoint of area of filter bottom and height of enclosing wall, the latter amounting to only 4.5 ft. in this case.

Distributor—The design of the distributor conforms to standard practice in every respect except that the capacity of the mechanism has been increased several fold over that for the trickling filter. In the present case, the distributor is capable of discharging as much as 3,500 g.p.m. under a head not exceeding 24 in. This discharge capacity permits a flow of recirculation equal to five times the sewage flow to be applied to the filter bed, based on a 1 m.g.d. rate of feed of clarified sewage from the primary settling tank. The influent and effluent channels, shown in Fig. 5 correspond to a pipe size of 24 in.

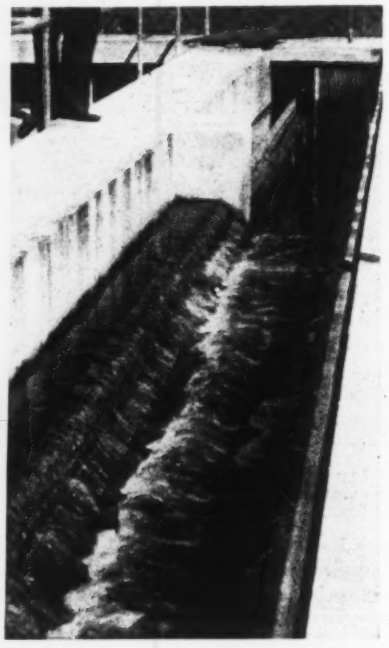

Fig. 6. **Final effluent coming over the weir of the detention-settling tank, a major part of which is returned to the bio-filter.**

The recirculation system comprises two pumps and pipe lines interconnecting the detention tanks (with primary settling tank bypasses), and the bio-filter. The pumps are single-stage axial-flow propeller type drainage pumps, having the following characteristics:

	Pump No. 1	*Pump No. 2*
Capacity, g.p.m.	1,800	1,200
Total head, feet of water	8	8
Suction and discharge	12 in.	12 in.
Electric motor drive	5 hp.	5 hp.

At the present time only pump No. 1 is used. It is anticipated that this 5 hp. unit will be sufficient to meet the recirculation requirements for a sewage flow of 0.5 m.g.d. corresponding to one-half ultimate population. On this basis the power per million gallons amounts to 10 hp.

A certain amount of short-circuiting or under-treatment is unavoidable in all processes where mixing, agitation or aeration takes place, particularly in a single unit such as the bio-filter provided in the initial design for the Camarillo plant. However, this has been reduced to a minimum by causing the effluent from the primary settling tanks to flow directly to the bio-filter before it is possible for any portion of this added material to reach the detention settling tanks without having first gone through the biologic filter medium at least once. It is evident from the plan view of Fig. 2 that the counter-flow of recirculation toward the effluent well definitely precludes any primary tank overflow from traveling in the direction of the final effluent and reaching the effluent outlet before having gone through both the bio-filter and the detention tanks.

The view shown in Fig. 6 was taken looking towards the effluent outlet and shows in detail the flow of recirculation and indicates the clarity of the effluent.

The usual sludge digestion and disposal facilities are provided. Sludge may be withdrawn from any or all tanks and discharged to the digester, the drying beds, or returned to the recirculation system.

Chlorine is fed by a standard vacuum-type chlorinator and applied at any or all of three points in the system, comprising the raw sewage, the recirculation return line, and the plant effluent.

The plant is provided with a complete system of inside, outside and interconnecting piping. A full complement of valves and bypasses ensures the utmost flexibility of operation. Complete facilities are available for some dozen sequences and combinations of operation in respect to sewage treatment, sludge handling and disposal, and bypassing of individual plant units.

An effluent storage pond has been provided in which to store the output of the treatment plant for subsequent periodic release over adjacent land for irrigation purposes.

Plant operation

At the very beginning the plant was subjected to an extraordinary test of the capacity of the process to cope with abnormal conditions. For more than a month prior to placing

the treatment work in operation, sewage had been allowed to accumulate in all the tanks, and it had become completely septic, black and odoriferous. However, by over-night recirculation through the filter bed (before any biologic life could possibly have established itself in the bio-filter) all the undesirable sewage characteristics were eliminated.

Periodic inspections of the Camarillo State Hospital plant during the past ten months' operation, have found the plant serving a population of approximately 1,250 persons and in addition, taking care of a substantial contribution of laundry wastes from which it is producing an effluent that is sparklingly clear, odorless and stable. The water is of such high quality that it is planned to stock the irrigation pond with fish.

Incidental operating characteristics of the plant include rapid digestion of the sludge without foaming; freedom from plant odors; and practical elimination of filter flies. The digestion tank supernatant is being successfully disposed of by returning it to the recirculation system through a connection with the 24-in. bio-filter influent line.

Cost and personnel

The contract cost of the complete plant was $84,900 including a special item of excavation into the hillside at the site of the plant to ensure satisfactory foundation conditions, and the irrigation water storage pond of approximately 2 acre-ft. capacity. Allowing for these additional features, the net construction cost of the plant itself was $75,000 per m.g.d. capacity. The contractor for this work was Fred J. Early, Jr., of San Francisco, while the major equipment was supplied by The Dorr Co., Inc., the Link-Belt Co., The Kimball-Krogh Pump Co., and the Chicago Pump Co., who furnished the bio-filter distributor, the detention-settling tank sludge collectors, the sewage and the recirculation pumps, and the sludge pumps, respectively.

As an integral part of the building program for the Camarillo State Hospital, the sewage treatment plant was designed and constructed by the division of architecture, California Department of Public Works, under the direction of George B. McDougall, state architect and chief of the division, and in immediate charge of W. H. Rockingham, principal mechanical and electrical engineer. The writer served as consulting sanitary engineer on the project. Resident engineering inspection was furnished by C. M. Weber and F. R. Austgen, associated with the Los Angeles office of the division of architecture.

Camarillo State Hospital is maintained by the state Department of Institutions of which Harry Lutgens is director. Thomas W. Hagerty, M.D., is medical director and superintendent in charge of the institution, and the sewage treatment plant is operated under the direction of Louis Mechler, chief engineer.

Planned Community to be Built On the Site of a Destroyed Town

Property owners in Bandon, Ore. pool their land to aid in creating a model town

SOMETHING NEW in the way of city planning is proceeding in Oregon. It is the entire reconstruction of the town of Bandon-by-the-Sea, a small industrial community with a population 1,500 which burned to the ground in a forest fire not quite a year ago.

Described in a special bulletin issued by the American Society of Planning Officials, the rise of a new, planned-in-advance Bandon will rest upon the united action of property owners in pooling all of their land for the community. The cooperative property pool has been effected, and the completion of financial arrangements, now under way, will see the start of construction.

Old property pooled

The first step toward reconstruction after the disastrous fire was taken when Governor Charles H. Martin of Oregon asked Ormond R. Bean, chairman of the Oregon State Planning Board, to offer local officials the assistance of the board. A number of business and professional men who had previously proposed relocating the business district on a site more easily accessible from the residential areas and the coastal highway supported the board's recommendation to build a well-designed, modern city of modest proportions on a new site within the old town boundaries.

The property pool, formed within six months after the fire had destroyed $3,000,000 worth of Bandon property—practically all of it—brought local land-holders under an agreement that gave clear title to a special holding corporation or trustee, the Coos Bay National Bank. The agreement authorized a Citizens' Rebuilding Commission to place a valuation on each lot included in the pool on the basis of the 1936 appraisal, and to negotiate with the Coos County Court for the purchase or exchange of any county-owned parcels of property within the city or immediately adjacent to it. Later, when the final plans for the new town are completed, the commission will re-allocate the land, giving to each property owner parcels of property equivalent in value to what he contributed to the pool.

When the city plan, which has now been approved by Bandon's citizens, was being evolved, these were some of the principal points considered by the plan makers: (1) selection of the site; (2) determination of the economic size of the town; (3) provision for possible future expansion to care for additional population and new industries; (4) arrangement of principal features and street pattern and (5) general appearance of the city and its architectural treatment.

The main site of the new Bandon will lie within the limits of the

burned city, on high land overlooking the Pacific Ocean on the west and the Coquille River on the north. For the new town a developed area of only 450 acres, as contrasted with 905 acres in the old town, is needed to provide adequate residential, business and industrial districts, parks and school sites, a resort section, and the street system. To protect the city from the waste of land and money proceeding from excess subdivision platting, and to provide reserves for future expansion, a belt of undeveloped land, zoned partly for agriculture, is to adjoin the city on the south and east.

The business center, the civic center, the educational and recreational group and the resort area are located at various points along a straight, wide central boulevard running east and west. The business district is relocated to provide adequate and safe traffic access to the rest of the city and to the main highway passing the town.

Parking areas in the business district are located in the interior of business blocks. Nearby space is set aside for filling stations, garages and light manufacturing establishments of a type not objectionable to adjoining retail stores or residential areas. On "main street" frontage is available for drugstores, groceries, banks, hotels and the like. Transition from the business district to the residential area is to be accomplished by means of a civic center for public and semi-public buildings. An educational center is located on the central boulevard between the business district and the oceanside resort.

A definite use for each street is contemplated in the street pattern that has been laid out. The business district is surrounded by a belt boulevard that connects with the main highway. Width of the minor streets, in residential sections, will be determined by the use to which they will be put. Blocks are longer and fewer in number than in the old town.

High Speed Shield Tunneling

Heading on concrete block lined Detroit interceptor tunnel advances 50 ft. daily, a record for compressed air shield driving, through ingenious plant layout

A RECORD SPEED of 50 ft. per 20-hr. day is being steadily maintained in advancing a 22-ft. shield through soft clay under compressed air on Sec. 12 of the Detroit interceptor sewer tunnels. Within the shield is erected a primary lining of precast interlocking concrete blocks, 18 in. thick and 30 in. wide. The daily progress (four 5-hr. shifts) of 50 ft. means that a shove of the shield and erection of a new ring of lining must be completed every working hour. Occasionally more than twenty shoves are made in one day, and in a few instances the amazing speed of 27 rings, or 67½ ft. of tunnel, have been completed in 20 hr. Some distance behind the shield an inner monolithic concrete lining is being placed in two sections, invert and arch, at the rate of 50 ft. a day to keep pace with the heading advance. Analysis of the job reveals an unusual coordination of all activities in connection with an ingenious plant layout, sketched in Fig. 3.

The nearest approach to this speed in driving was the 40-ft. sustained daily progress and a high run of 45 ft. on the Lincoln tunnel in New York (*ENR*, June 24, 1937, p. 955). Though the Lincoln Tunnel heading had twice the face area, only 20 per cent of the displaced silt was admitted through the shield, and this was left in the tunnel as ballast until driving was complete. At Detroit, however, all of the displaced muck is carried through the shield and is hauled out immediately, thus creating a mucking problem not present at Lincoln Tunnel. Also at Detroit tunneling operations are carried on only 20 hr. per day.

Section 12 is a part of a long interceptor sewer being built from downtown Detroit to a proposed treatment plant near Rouge River at the southwest edge of the city. In addition to this section, which leads into the plant, adjacent Sec. 11 and the outfall sewer will be shield driven. Other sections, some of which are completed, are of the type of construction characteristic to Detroit clay—excavation by power and hand knives, primary lining of pressed steel plates braced by steel ribs or needle beams or both and lined with monolithic concrete. All tunnels are of circular cross section, and are driven under compressed air.

Shield driving

The use of a shield and concrete block lining were optional with the contractor, as the specifications merely call for a tunnel of 16-ft. finished diameter with 16-in. monolithic concrete lining, paid for on a unit price per foot of tunnel. Because of lack of a suitable location elsewhere, the contractor had to sink a shaft at the outlet end of Sec. 12, at the disposal plant site, and work the entire tunnel (5,688 ft. long) from one end. As this contractor also has the adjoining Sec. 11, 4,527 ft. long, he intends to work the second job from the first shaft, which will eventually run into a heading 10,215 ft. long.

The project is ideal for shield driving. The clay is of such characteristics as to permit shoving into the face and bringing the muck into the tunnel through small openings in the shield bulkhead, thereby simplifying the mucking operation. Then, too, the

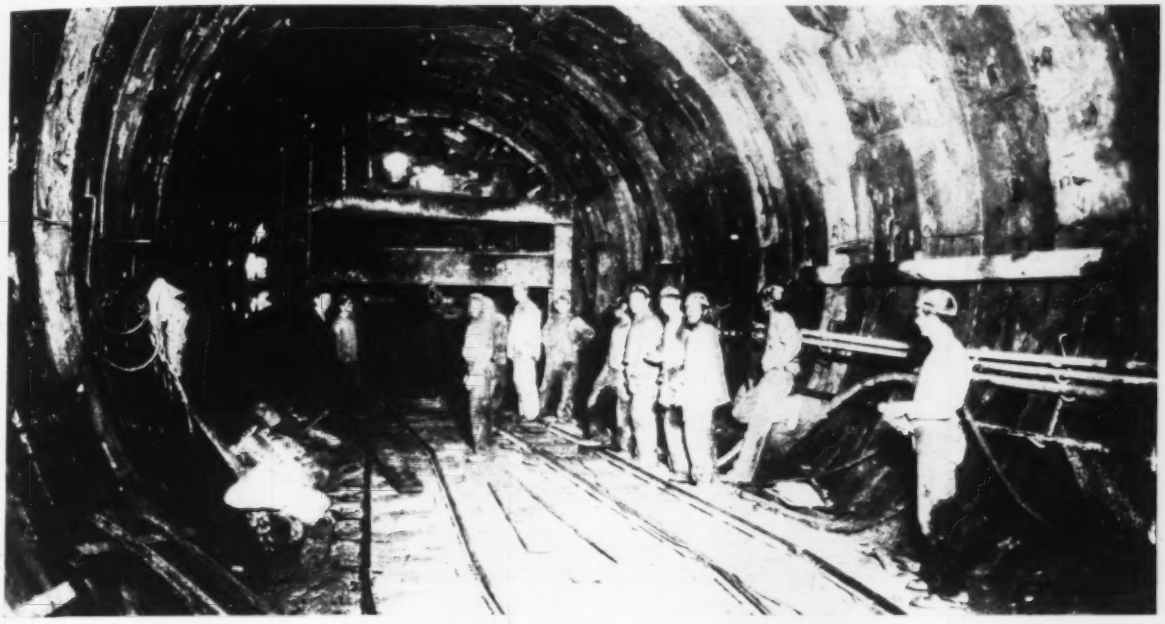

Fig. 1. Shield-driven block-lined sewer tunnel advances 50 ft. daily at Detroit. This is a view of the heading

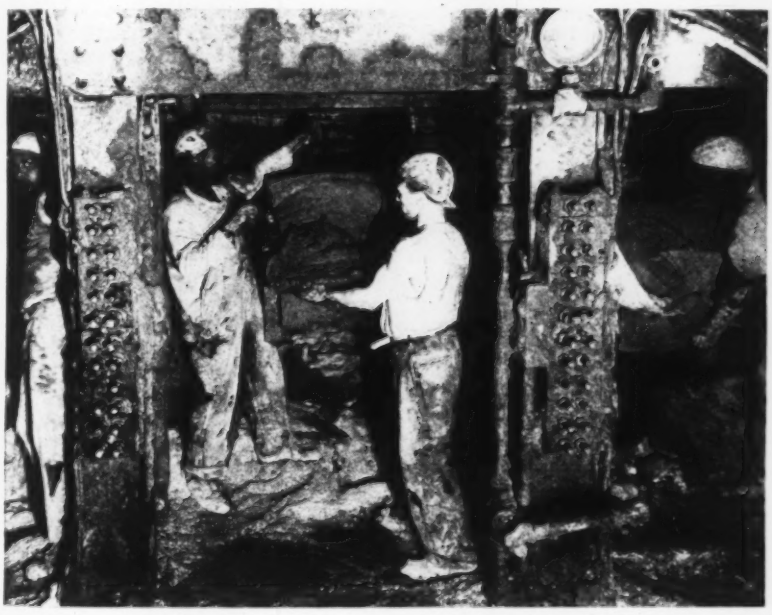

Fig. 2. Detroit blue clay streams through openings in the shield like Hudson River silt. The ribbons are cut into chunks by wire loops and dropped into waiting cars in the shield chamber.

job is long enough to warrant the expense of a shield, and in addition, driving from one shaft saves the cost of sinking additional shafts, which would have been necessary under any other method of tunneling.

The precast interlocking concrete blocks for the primary lining are the type developed by the late John F. O'Rourke, and used previously on two large jobs, the Prospect Park subway tunnel in Brooklyn (*ENR*, Nov. 20, 1930, p. 796) and the Ford water tunnel in Detroit (*ENR*, Aug. 6, 1931, p. 202). Ten segments form a ring of lining 30 in. wide and 18 in. thick. Details of the blocks are shown in Fig. 4. A great improvement has been made on the present job by splitting one segment into two key parts, which are set as the ring is erected, and are locked in place by a concrete shear pin inserted in grooves cast in the radial joint of the key. Previously it was necessary to insert a wooden dummy key to complete the ring, then remove the dummy and slip the closing block in from the front after the next shove of the shield.

The shield is standard type, 14 ft. 11 in. long with no overhanging cutting edge. It is equipped with twenty 10-in. hydraulic jacks for shoving, and carries a steel bulkhead containing six 2x2-ft. openings controlled by hydraulic gates. Closely following the shield is a traveling jumbo carrying a hydraulic erector arm on the front end. Mounted on semi-circular ribs on the jumbo are ten 6-in. longitudinal I-beams spaced equally around the upper half of the tunnel circumference. These beams, extensible through roller supports, are shoved ahead as cantilevers to support the blocks as they are erected in rings until the key is closed. Blocks are carried through the jumbo to the erector by a monorail hoist.

Shoving cycle

During a shove of the shield practically all of the displaced ground is admitted through the top three bulkhead openings, though the bottom gates are available if needed. An at-

tempt is made to build up just enough ground pressure ahead of the shield to raise the street or ground surface about ¾ in., which insures no loss of ground. Experience has shown the timing and size of gate openings necessary to accomplish this result.

As the three ribbons of muck stream into the shield pockets they are cut into chunks by wire loops. The manner in which muck-handling has been worked out is responsible for much of the driving speed. A shove produces 36 cu.yd. of muck, about 40 carloads. A 40-car train of empties is shoved into a siding close to the jumbo. Double crossovers from this and the main line track connect with two tracks leading into the shield. Muckers drop the chunks of mud into a car on one of these tracks; when it is filled they work the empty car on the other track. While that car is being loaded the previously filled car is jerked back onto the main line by an air hoist line and an empty car is dropped into its place. As the loaded cars string out on the main line they are hauled away in trains of eight to ten cars each, though with these trackage arrangements mucking operations are independent of the haulage.

At the end of a shove the bulkhead gates are closed to protect the face. As soon as the muck cars are out of the way, a trainload of blocks on flat cars is brought in, the jumbo is moved ahead and erection of the new lining ring begins. The ring is built up in the lower half first, then as blocks are alternately placed above the springline on each side, the supporting beams are moved forward to hold them in place.

The annular space left by the tail of the shield between completed lining and the ground is filled with pea gravel packing during the shove. Gravel is shot through holes in the blocks in the fourth ring back of the shield from a gravel blower mounted on the jumbo. Packing is placed behind the upper blocks only as the combination of settlement of lining and rise of ground at the bottom closes the lower space almost instantly.

Dumper handles muck cars

From the shield, muck cars are hauled through a 9x84-ft. air lock to the shaft, where they are hoisted two at a time up a shaft containing two independent skips. A double-drum electric hoist handles the skips which raise the cars to a tipple above ground level. In this tipple is a two-car capacity rollover car dumper (Fig. 5), one of the high spots of the job. Getting the sticky blue mud out of the car has always been a problem in excavating Detroit clay, but this contractor makes short work of it. The dumper rolls over in either direction, discharging into hoppers from which the muck is dumped into trucks for final disposal. A small air hoist motor operates the dumper through an endless cable.

Monolithic lining

The concrete plant set-up for placement of the inner monolithic lining is in keeping with that for driving, designed for a steady progress of 50 ft. of complete lining per day. Concrete is supplied by the block making plant, located not far from the shaft, and is delivered to the tunnel through bore holes along the line, which are capped at the surface by small air locks.

Invert concrete is placed in 50-ft. sections, 100 ft. ahead of the arch, in the 4-hr. layoff of the driving crew; for the tunnel track is torn up at point of placement. Steel forms used for the invert are both supported and held against uplift by hangers and bracing fastened to erector grip holes in the sidewall blocks. Concrete is hauled from the nearest supply hole in cars for dumping into the forms. Usually only one hour is required for pouring the invert.

The remainder of the lining is placed in one pour with use of two complete sets of steel forms, each 50 ft. long. One set is collapsed and moved ahead through the other set while the first set is in use. These forms are filled by a pneumatic placer

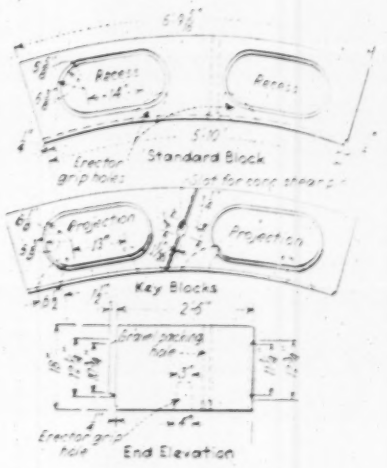

Fig. 4. Details of the blocks for primary lining. A great improvement is the split key block held by a concrete shear pin. The blocks interlock through lugs and recesses.

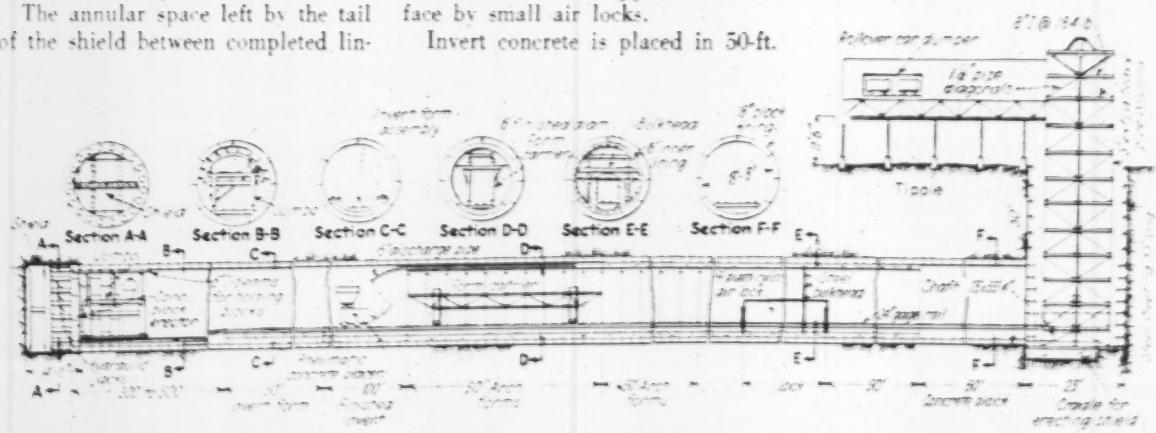

Fig. 3. An efficient job layout is responsible for the fast driving speed. This schematic sketch shows the relation of the various operations. Invert concrete is placed in the 4-hr. shutdown of driving; arch concreting is worked along with excavation.

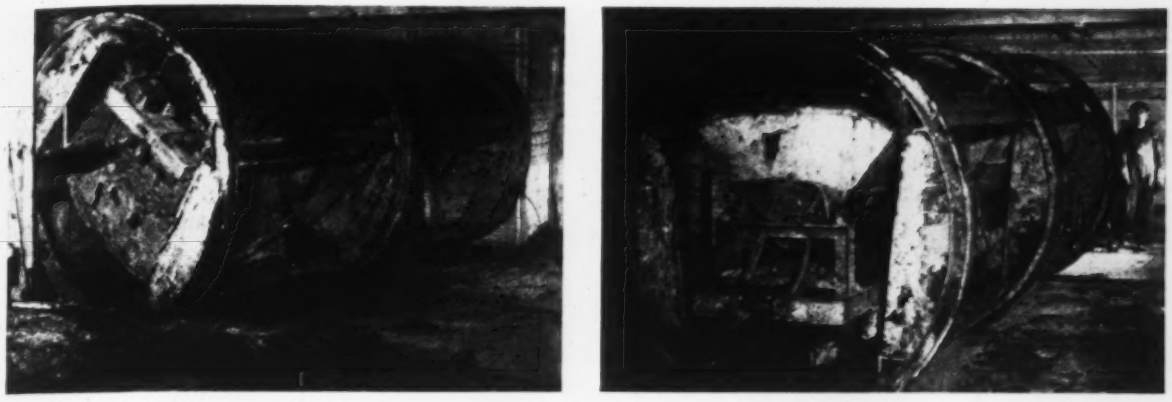

Fig. 5. Over she goes! The neatest trick on the job is the rollover car dumper which quickly dumps the sticky mud without necessitating hammering or scraping of the cars

Fig. 6. The best of jobs have their moments of grief. Here the street slumped over the tunnel line along a stretch close to the Rouge River

cer. When possible the placer is set directly under a supply hole; otherwise concrete is hauled in cars to a belt conveyor that feeds the gun. The arch is shot in about four hours.

The arch concrete is cured by water spray delivered from a gantry that follows behind the forms. Spray nozzles on a series of curved pipes direct a mist against the concrete.

Shaft and top plant

The shaft, 23x34 ft. in plan, was sunk 50 ft. deep within steel sheet piling and I-beam waling ground supports. Inside the shaft was erected a two-cage hoist frame, built up of 3-in. pipe posts and 1¼-in. pipe bracing.

At the surface is a compressor plant of five large low-air and two high-air units, all electric driven except one of the large compressors, a vertical compound, which is directly connected to a six-cylinder 240-hp. diesel engine. The compressor house also contains two hydraulic pumps and an accumulator for propulsion of the shield.

All of the precast blocks for the primary lining are made at a nearby plant. Concrete is turned out in a well-equipped central plant with two 1-yd. mixers. The blocks are cast on flat cars (450 on hand) with the floor making up the bottom form containing the radial joint lugs. Sidewalls, which form the curved faces, and the end pieces are removable, and a top form is pressed into the filled car to make the radial joint recesses. Internal vibrators on the forms assure a smooth block surface on all sides.

After 24 hr. the forms are stripped and the blocks are lifted off the cars by an overhead traveling crane, transferred to regular flat cars and taken to the storage yard. Blocks remain in storage for at least 28 days. They are handled on and off the yard cars by a crane, and once loaded for the tunnel are taken direct to the heading without further handling.

Sideslip causes settlement

As stated above, the shield is operated to exert a pressure sufficient to raise the ground surface about ¾ in. to prevent settlement of streets and buildings. The cover is only 20 to 25 ft. above the shield, and careful judgment is required in admitting muck into the tunnel to maintain the desired raise of ground. For the most part this procedure has proved effective in preventing settlement of ground and buildings.

However, at one point, where the Rouge River cuts within 55 ft. of the tunnel, trouble was experienced with ground settlement. Apparently a sideslip into the river caused a corresponding slump in the street over the tunnel, though the authorities are not in agreement as to just what happened or the cause of the settlement. A section of West Jefferson St. 650 ft. long, carrying car tracks, sunk a maximum of about 5 ft., causing damage to several buildings on the river side of the street and affecting an adjacent pier of a Pere Marquette RR. bridge (Fig. 6).

Direction

The tunnel is part of the Detroit River interceptor sewer being built by the city as a PWA project. L. G. Lenhardt, commissioner of public works, is in general charge. Leo V. Garrity is in charge of construction of the tunnels for the city. Contract for Sections 11 and 12, described above, is held by the S. A. Healy Company of Chicago. Harvey Kruse is general superintendent.

A LIMEROCK ROAD IS AS CHARACTERISTIC OF FLORIDA AS IS ITS SEMITROPICAL SETTING.

Fine Florida Roads of Limerock

Primitive use of a native road material has been developed by engineering study to a notable technique of low-cost road construction

Among characteristic local materials for road building the limerocks of Florida and the southern parts of Georgia and Alabama occupy an enviable position. Winter travelers in Florida recall the main roads of limerock for their fine riding qualities but they are more than this; few roads have a more solid structure, wider shoulders and more ample rights of way. The soundness of structure comes from sound drainage and foundation engineering but also and largely from the limerock material and its skillful use. What then is this material?

What is limerock?

Limerock is limestone but not the consolidated grade that is commonly thought of for building stone, concrete aggregate and macadam road metal. Nor is limerock to be identified with the unconsolidated marls. Like both marl and hard limestone, limerock is predominately calcium carbonate but it occupies an intermediate zone of consolidation. In physical appearance limerock is often described as semi-crystalline, fossiliferous, shell, chalky, colitic, sandy and cherty or flinty. These terms also in a measure indicate origin and of course, in the case of the last two, intrusions of silica in the lime mass.

The commonly used limerock deposits of Florida are the Ocala, Mariana, Glendon, Tampa, Miami and Coquina. As indicated by the names the distribution is wide. All of these deposits or the parts of better quality are used in road building. In general they are quarried above water level but some of the Miami deposits are dredged from below water. Commonly the rock is soft and powdery but it carries hard streaks so that the usual quarry operations are blasting, loading with power shovels and crushing. In color the crushed material is white, cream or light gray but the darker shades bleach to white when exposed to the weather.

Tests indicative only

Tests appear to be rather unsure determinants of limerock quality for road building. In 1935 the Bureau of Public Roads reported a study of limerock involving chemical and mechanical analysis, slaking tests and determinations of shrinkage, liquid limit, plasticity index, and flocculation factor. The tests were made on samples selected from rocks that in experience were rated as excellent, good, fair and poor. As reported (*Public Roads*, October, 1935) the conclusions were as follows:

"The results indicate that the tests of greatest value for predetermining the quality of roadbuilding limerocks are the plasticity, the field moisture equivalent and the flocculation tests. While present information does not warrant the establishment of rigid limiting values, a plasticity index of 0 to the exclusion of all other determinations appears sufficient to indicate those limerocks that are likely to perform satisfactorily as base-course material under practically all conditions; a plasticity index from 1 to 7 and a field-moisture equivalent not exceeding 20 indicate limerocks that will perform satisfactorily in carefully constructed base courses under average conditions; a plasticity index from 1 to 7 and a field-moisture equivalent greater than 20 indicate limerocks that will perform satisfactorily in carefully constructed base courses under fairly dry conditions, and a plasticity index of 8 or more indicates limerocks that are likely to prove troublesome.

"Use of the foregoing tests does not eliminate the desirability of using the chemical analysis in certain cases, such as those in which the quality of material within a given deposit or formation has been found to vary with the calcium-carbonate content.

"The flocculation test seems of sufficient significance to be useful for the preliminary field examination of limerocks. A flocculation factor exceeding about 1.9 will indicate material unsuitable for base-course construction, thus eliminating the necessity for any further tests. A flocculation factor under 1.9 will not necessarily indicate a satisfactory material and must be supplemented by plasticity and field-moisture equivalent tests for definite identification. Use of the flocculation test in the field, however, will in some cases eliminate the inconvenience of sampling and transporting materials to a laboratory for further testing."

With so excellent a road-base material at hand, a large mileage of roads to be made attractive to tourists and, like other states, a need for economy in construction, Florida highway engineers have centered attention on the technic of limerock road design and construction. The practices developed are outlined in the following article by T. B. Massie of the Florida Road Department.

Limerock Roadbuilding Methods

by T. B. Massie

Engineer of Roadside Improvement, State Road Department, Tallahassee, Fla.

Nearly every state has some native material that permits the construction of satisfactory road surfaces without the costly importations that enter the higher types. In Florida the native material is limerock. The deposits are located mainly in the center of the state, thus enabling the use of the product over a large area before freight charged become prohibitive. There are many commercial producers, and the price will generally run about 90c. per ton f.o.b. at the plant. About 0.44 ton to the square yard is required for an 8½-in. base.

Design elements

The first use of limerock for Florida roads goes back many years, and was but a crude method of keeping traffic above mud or lose sand. Like most other metals it would be useless under present day conditions except for the developments in asphaltic surface treatments. Today we have about 4,600 mi. of these types of pavement in the state system and the major part of state and federal funds is put into them. The pavement which this material makes is best compared with a very-high-grade pit gravel road or about equal to a macadam.

We are building two classes of this pavement. One is a 6-in. single-course construction and the other is 8½-in. two-course construction. For several years past all pavements have had a width of 22 ft. We prefer the 6-in. type on all initial paving. Regardless of the thoroughness with which present-day earthwork is compacted nothing but time will give it the ultimate settlement which is desired. Through the use of this 6-in. depth, with a light surface treatment, the pavement is carried through those three or four seasons required to gain ultimate settlement. At that time one is justified in reworking the pavement and bringing it up to a higher class: The old surface treatment is taken off, the base is scarified, new limerock is added to increase the thickness, and the best surface treatment is applied. This final pavement will maintain its smoothness because of the settled first course.

Hand in hand with elastic first-stage construction go the foundations. Through the last 25 years of highway evolution these have been a most neglected element until fairly recent-

Fig. 1. Florida limerock roads express the modern idea of road design by 200 ft. rights of way, wide shoulders, asphalt protected ditches and flat back slopes.

ly. We have been thinking only of pavements and have put them, both elastic and rigid, on roadbeds that were entirely incapable of carrying them. I subscribe to the belief that greater attention should be given to foundation and that pavement be viewed in the light of a wearing surface only. Possibly this would reduce costs and certainly it would result in better riding roads. Recent progress in methods of stabilizing inferior soils offers aid in developing better foundations for future pavements.

Laying limerock base

The operations in laying limerock are relatively simple. The material reaches the railroad siding in gondola cars from which it is handled by a clam-shell to the trucks. The road sub-grade is accurately dressed as for concrete, with uniform crown of ¼-in. to the foot. Wood forms are used because of the necessary rolling adjacent to them. The laying process begins on the near end of the project, thus making the haul always over the newly-spread material. This helps to develop maximum compaction. The spread at the dump on the grade is handled by laborers about the same as at a concrete paver. At this stage water from a 2-in. pipe line is played on the spread material. Rolling with three-wheel 10-ton rollers now begins, and is kept up until thorough compaction is gained. There will generally be four rollers on the average operation, as each is limited to compacting 60 sq. yd. an hour. The rolling leaves the base in a reasonably regular condition.

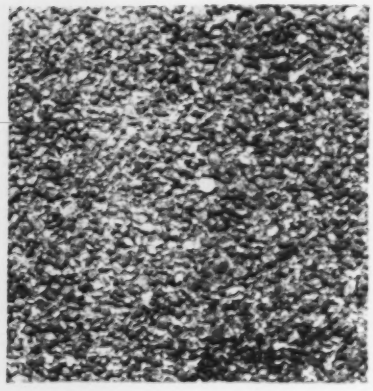

Fig. 2. Limerock roads surface treated with asphalt and fine stone or slag have a uniform nonskid top remarkably easy to ride.

The finishing and shaping operation follows in about three days. First, a roller with scarifier rips the base to a depth of several inches a small amount of water is added if needed and a long-wheel-base road machine tapes up the shaping. Rolling is again employed along with and after the shaping. The finished surface is held to the same permissible variations as is a concrete pavement.

Immediately after finishing, the base is dense and hard but damp and must be left to cure for about four weeks. Traffic is immediately put over the pavement as it helps in this developing process. An advantage of this construction is that there is a minimum of interference to traffic.

After the curing is complete the pavement is swept and primed with 0.15 gal. per sq. yd. of tar prime. Penetration will extend into the base about ¼ in. and usually in about ten days the surface is ready for the asphalt application.

Two types of surface treatment, a single application and a double application, are used. The single application consists of 0.45 gal. of oil asphalt with 0.55 cu. ft. of cover material per sq. yd. The cover material available in Florida is either slag or a native stone. In the double application a total of 0.5 gal. of asphalt and 0.75 cu. ft. of cover material is used. The first shot is 0.2 gal. and 0.5 cu. ft. of coarse cover material and the second shot is the remaining 0.3 gal. and the 0.25 cu. ft. of fines of the cover material.

The only difference in the construction of a 6-in. and an 8½-in. base is that the former is laid in one operation and the latter in two. On the 8½-in. base the bottom course is kept several hundred feet ahead and is subjected to a separate rolling. The theory is that in this thicker pavement we get greater density through the double-course rolling.

Fig. 3. Limerock quarries look almost like excavations in snow where the Florida sun lights the white or cream colored rock.

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Real Property Inventory At Colorado Springs, Colo.

IN A REAL PROPERTY inventory of Colorado Springs, Colo. completed last year by WPA there were 14,092 dwelling units in 12,406 structures enumerated. Owner-occupied were 6,062 and tenants, 6,739 with 1301 vacant. Single family detached houses were in the great majority, 89.68 per cent. Apartment buildings number only 61 or 0.5 per cent. Wood houses predominate, 83.84 per cent; stucco next, 11.77 per cent, and brick next 3.33 per cent. Nearly half, 48 per cent of the structures were built prior to 1904. Only 41.37 per cent were in good condition, 37.48 needed minor repairs, 20.20 per cent needed major repairs and 114 or 0.95 per cent were unfit for habitation. This is a one-story city, 69.21 per cent being in that category, only 1 is 4 stories or more high. One-half have basements. Only 4.25 per cent are valued above $10,000 and but 34.72 per cent are mortgaged. The total cost of the inventory was $17,162 of which the city furnished $863 only.

Thin-Core High Earth Dam

by ORMAN M. STRANGE
Field Engineer, Board of Water Commissioners, Denver, Colo.

High clay content of material selected for core of Ralston Creek Dam permits unusually thin central section but requires exceptional care in construction

FAR UP on the broken mesa that sweeps westward from Denver to the foothills of the Rockies the city is building one of the highest earth dams in the world at Ralston Creek. Exceptional care is required in the construction of this dam because of the relatively high clay content in the material used in the core, which is of unusually thin cross section. A soils laboratory on the site is of great aid in checking and controlling the material going into the core.

The dam will contain 2,400,000 cu.yd. of rolled fill, protected by riprap face coverings and rockfill toes.

The Ralston reservoir, located on Upper Ralston Creek, 20 miles northwest of Denver, will serve as a storage and distribution reservoir for a part of the water Denver is diverting from the West Slope through the pioneer bore for Moffat Tunnel into South Boulder Creek. A conduit system of canals and tunnels carries the water from South Boulder diversion dam along the foothills to the new reservoir. A general outline of the diversion project was published in *ENR* Sept. 12, 1935, p. 357. The map, Fig. 3, shows the various features.

Located to avoid pumping

Diversion through the Moffat Tunnel is possible only in the summer months, usually from May 15 to Oct. 1, which necessitates storage to carry through the winter. A reservoir of at least 10,000 acre-ft. capacity was desired, and extensive surveys were made to find a suitable site in the region just below the foothills north and west of Denver. Many locations were considered, but most of them were eliminated, either because of high initial cost or because they were at elevations lower than required to deliver water by gravity and at sufficient pressure to several of the high areas in the city, and would have required a continuation of the present pumping service. Though it lacked the higher capacity found elsewhere, the Upper Ralston Creek site was finally chosen because it is high enough for gravity flow through the West Side filters, and has sufficient capacity to provide water for the city's high areas during the winter, at the same time eliminating use of the Ashland Avenue pumping station, thereby effecting a substantial operating saving.

Several features of the dam and appurtenant works are of interest. The

Fig. 1. Ralston Dam will create a reservoir for all-year distribution of West Slope water for Denver. This air view of early construction stage shows the inlet canal coming in at upper right and turning into irrigation bypass canal that ends in a steep chute below the dam. The two borrow pits are to the right of the canal. Excavation at the extreme left is the rock quarry.

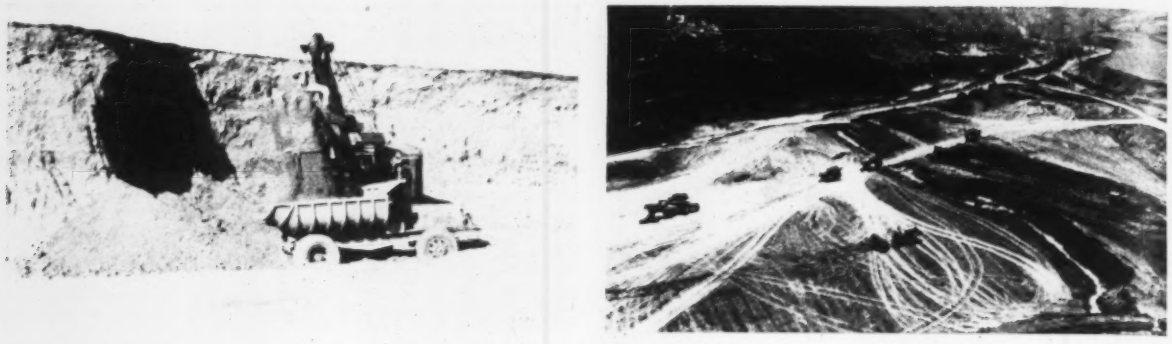

Fig. 2. From borrowpit to fill material going into the central impervious core is carefully controlled. At the pit each sweep of the shovel bucket must cut through several thin clay layers to obtain a proper mixture; at the fill the material is wetted to raise the moisture content and is then fully compacted by rolling.

central impervious core is kept to a minimum width, as shown in the cross section Fig. 6. This core consists of selected clay, sand and gravel, moistened and thoroughly compacted by sheepsfoot rollers. The upstream portion of the embankment is compacted sand and gravel; the downstream portion is sand, gravel and cobble with a heavy rock fill at the toe. The dam crest is 25 ft. wide and 1,150, ft. long.

The foundation of the dam is Pierre shale, dark gray or blue in color and of such characteristics as to provide a very satisfactory foundation material. It is very dense and will remain in its natural state indefinitely if moist, but disintegrates rapidly upon exposure to air. The shale resists percolation to a marked degree, a highly desirable foundation characteristic.

The design calls for four cutoff trenches 20 ft. wide excavated 8 ft. into the shale under the impervious core section. These trenches are carried across the base of the dam and up both abutments, where they converge into one towards the crest. A low concrete core wall is built into the second trench from the upstream side, being carried part way up the abutment slopes.

A tunnel 950 ft. long, driven through the Pierre shale, takes care of the creek diversion during construction of the dam and will form the controlled outlet works for the reservoir. For 260 ft. from the inlet portal the tunnel is a circular concrete-lined pressure section 10 ft. in diameter; the remainder is a non-pressure 10-ft. horseshoe section, heavily reinforced to resist possible ground pressure, and carrying a 60-in. steel pipe discharge line. Control of water from the reservoir will be

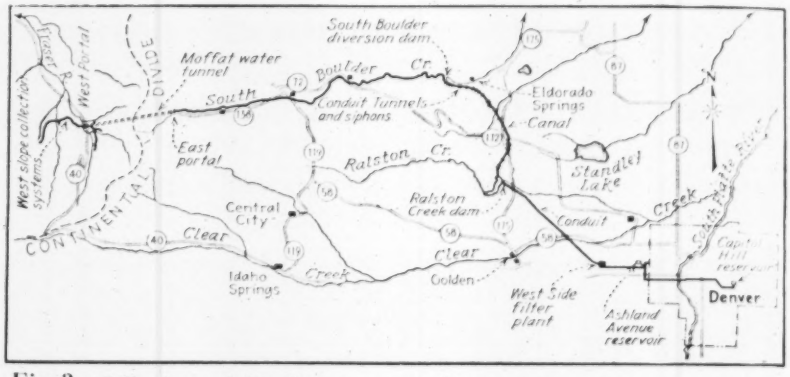

Fig. 3. Collection and distribution system of Denver's West Slope water diversion project. Ralston reservoir will provide storage for winter distribution when the collection works will be frozen up.

from three points: at the inlet portal is a 72-in. butterfly emergency valve; at the junction of the pressure and non-pressure tunnel sections is a valve chamber containing a 4x5-ft. hydraulically-operated slide gate; at the outlet portal is a valve house containing a needle valve and three cone valves, which control the discharge into the pipe line leading to the filter plant and a waste flow into Ralston Creek. The tunnel between valve chamber and valve house carries a lighted walkway. Power for the tunnel lights and for operation of the valves will be furnished by a gasoline generating set at the valve house.

Unusual spillway design

A bypass canal to carry water for exchange purposes leads from the main inlet canal past the north (left) abutment of the dam and discharges into the creek through a steep concrete-lined chute below the dam. This chute drops more than 200 ft. in a distance of 1,000 ft. The bypass canal forms part of the unusual spillway structure. For 320 ft. above the upper end of the chute the canal is a covered concrete conduit. At the junction of the conduit and chute is a low concrete weir, set at right angles to the conduit, which serves as the primary spillway discharging into the chute. This spillway has a capacity of 3,000 sec.-ft. before water will flow over the auxilliary spillway.

When the reservoir rises 4 ft. above the primary spillway level water will spill over the covered conduit, which acts as the lip of an auxiliary spillway. Waste water passing this way will flow into a deep borrowpit now being excavated as a gravel material supply for the dam and will flow into the creek ½ mile below.

The combined capacity of the two spillways and outlet works is 32,000 sec.-ft., double the previous maximum flow of Ralston Creek, as estimated from records of the state engineer and from flowage heights recalled by old inhabitants. This capacity is more than 600 sec.-ft. per sq. mi. of drainage area above the reservoir.

In May, 1936, a contract was awarded and work began. Prior to that time intensive studies had been

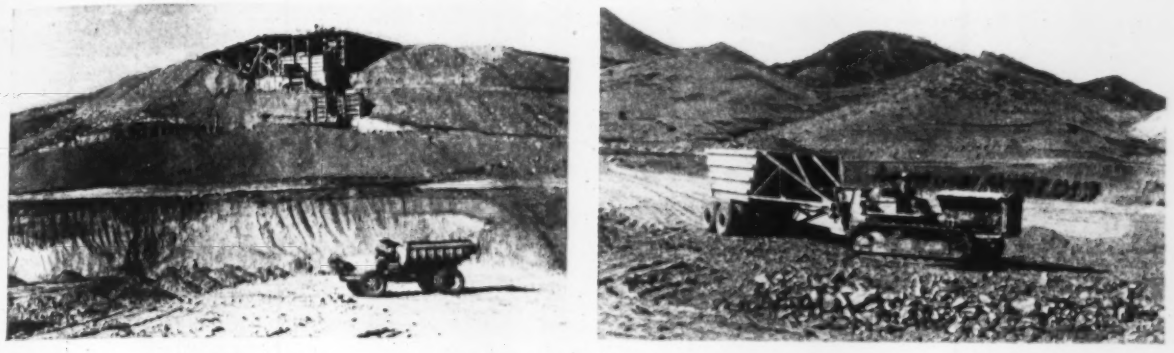

Fig. 4. Excess rock from the pervious material borrow pit is screened out in the plant shown at the left. Haulage from pits to fill is by 7-yd. trucks and 30-yd. tractor-hauled wagons.

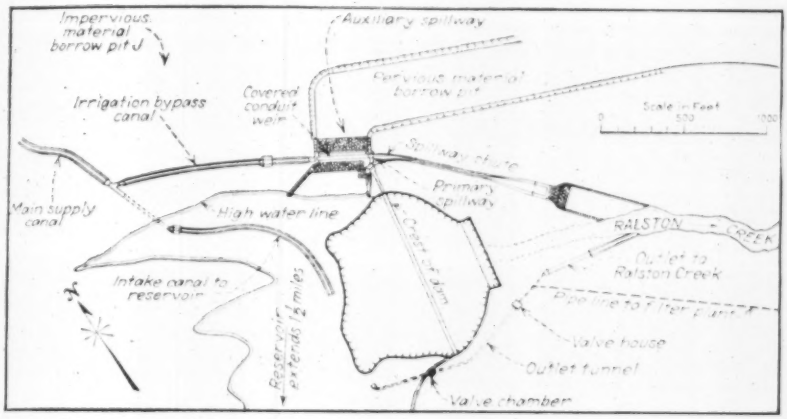

Fig. 5. Relation of the various features of the project is shown in this sketch. The covered section of the by-pass canal forms one weir in an unusual spillway arrangement.

made of the foundation, the character of the soils and formations encountered in the reservoir basin, and the suitability and availability of the soils for the construction of a compacted earthfill dam. These examinations were made by the staff of the board of water commissioners in a laboratory established on the site of the work. This laboratory, fully equipped with the most modern tools and devices for testing soils and determining their characteristics, is also serving during the construction as an aid in the control of the embankment. Extensive tests of all available sites for borrowpits adjacent to the dam resulted finally in the choice of two areas located on the mesa north of the dam, one from which materials are being taken for the impervious select core, and from the other those for the upstream and downstream portions.

The present borrowpit for supply of materials for the impervious section, designated as pit J, was a late discovery. Preliminary explorations had led to the conclusion this material would have to come from nine small and scattered areas located to the south and west of the dam. These pits, which aggregate 56 acres in area, would have permitted excavation from only 6 to 14 ft. deep. Such shallow digging, coupled with a long haul from scattered points, would have complicated the job of excavation and hauling. Now, however, the entire 900,000 cu.yd. of selected core material can be obtained from borrowpit J. Material from this pit runs from 12 to 25 per cent clay. The pit lies in a deltaic formation of material carried to its present location from clay deposits in the hills to the west and deposited on top of a strata of sand and gravel which forms the cap of the mesa to the east. In an area of 40 acres suitable material is found for an average depth of 20 ft. under a 2-ft. top layer which must be stripped. The average haul to the dam is 0.8 mile. Relation of various features of the job is shown in Fig. 5.

Fortunately, ample supply of sand, gravel and cobbles was found in a borrowpit located just to the east of pit J, estimated to contain 1,900,000 cu.yd. of material suitable for the pervious sections of the dam. The pit requires shallow stripping, mostly about 1 ft. and the material layer will be excavated from 12 to 15 ft. deep. This pit will form the outlet for the auxiliary spillway. The average haul to the dam is only ½ mile.

Placing the fill

Of the 2,400,000 cu.yd. of material to be excavated and hauled from the auxiliary spillway section (borrowpit C) and the selected core borrowpit J, the contractor has placed about 900,000 cu.yd., and is handling about 14,000 cu.yd. per day with three shovels and 27 hauling units in a well-planned, smooth-working operation. The hauling equipment consists of seven 8-yd. tractor wagons (loaded 12½ yd.), four 30-yd. wagons and sixteen large trucks with "bathtub" bodies. Selected clay material for the core is hauled in the smaller wagons; the sandy material from pit C is hauled from the shovel to the processing plant in the trucks, and from the plant to the fill in the large wagons. Two 2¼-yd. shovels and one 2-yd. shovel are used for loading at the pits. A 1½-yd. shovel works the rock quarry and handles miscellaneous jobs around the dam. Operations are thus continuous and it is seldom that a shovel actually stops for lack of a truck, though there is rarely more than one empty truck waiting at a shovel. Seven diesel tractors, three of which are equipped with bulldozers, are used on the fill. The contractor has well-equipped shops at the site of the work for repairing and servicing all equipment.

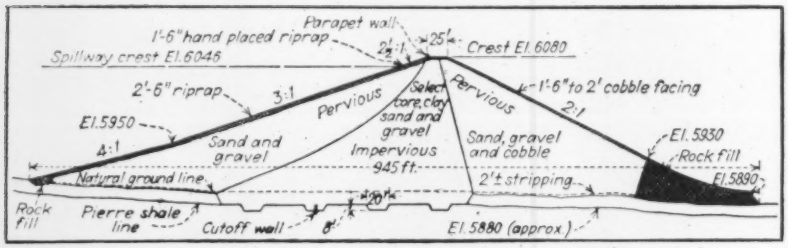

Fig. 6. High clay content makes possible a thinner impervious core than is usual in dams of this type. Note the very heavy rock fill at the downstream toe.

Material for the core section goes direct from pit to fill, as this pit so far has yielded little rock in excess of the 5-in. maximum size permitted by the specifications. Such stones as do exceed this limit are picked out by hand at the fill and are hauled away in stoneboats and trucks.

Specifications limit the size of rock in the upstream and downstream pervious sections to 8-in. maximum. As the run of material from the pit contains much stone over this size, it is necessary to screen out the oversize through a grizzly and loading chute set just below borrowpit level. Screened material is dumped direct into a haulage unit for transportation to the fill. Screened material, as above described makes up the downstream pervious section also, and rejected cobbles from the grizzly will be used to pave the downstream face of the dam.

Rock for the toe fills and paving of the upstream face comes from a quarry in a basalt outcrop south of the dam. It is hauled to the dam in trucks and is bulldozed into place in layers not exceeding 4 ft. in thickness.

The central core is built up in 6-in layers. Material from the pit contains about 16 per cent moisture, and sprinkling of the fill from hose and tank wagons, particularly on hot days, is necessary to maintain the moisture content at the specified requirement, usually about 16 per cent. The trucks and wagons dump the material in piles or rows, and a few passes with bulldozers serve to spread the dumped material to even thickness. The core is carefully compacted by at least twelve passes of a sheepsfoot roller, loaded with water and exerting a pressure of 250 lb. per sq.in. on the fill. The rollers are drawn by crawler tractors in circular or elliptical routes for maximum coverage of the fill. Compacted materials register approximately 550 lb. by the needle test.

Special care is taken to consolidate the core material in the cutoff trenches. These cuts were purposely made wide enough to permit compaction with the sheepsfoot rollers, and the material next to the side of the trench is compacted by gas-powered tamping machines.

The two pervious sections are built up in 8-in. compacted layers along with the central core fill. Compaction is by six to twelve passes of the sheepsfoot rollers. Materials in both the pervious and impervious portions are compacted to 85 per cent of their volume in the pits.

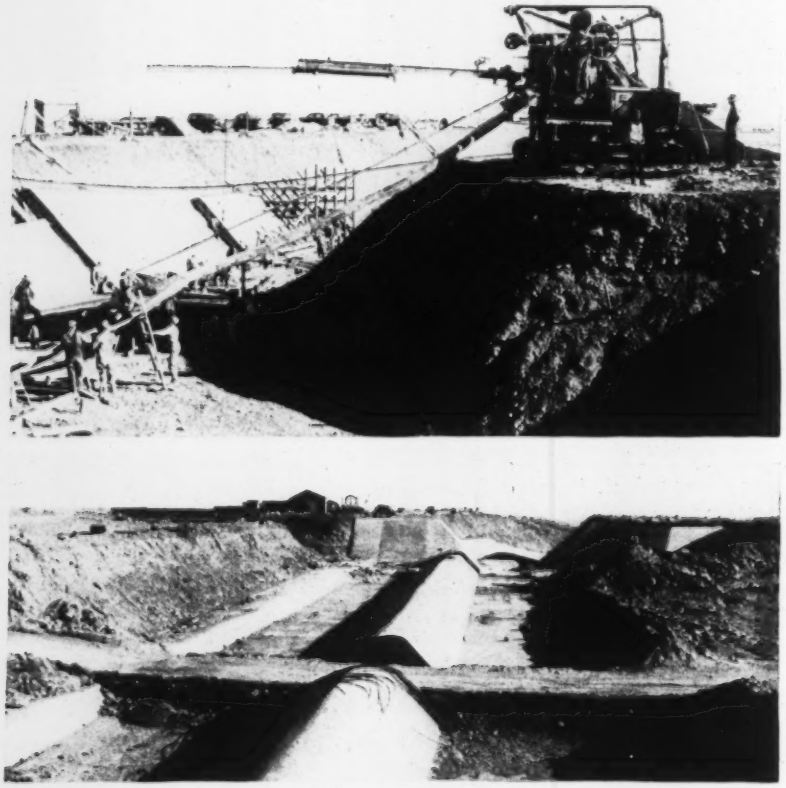

Fig. 7. Appurtenant works, such as the spillway and by-pass canal, are important items in the construction program.

Rains slow up work

Placing of dirt in the dam was stopped from Jan. 1 to March 1, due to cold weather and excessive frost in the ground. During that time, however, it was possible to work at stripping abutments, and to complete the concreting operations in and adjacent to the tunnel. As a result, at the beginning of the spring season the contractor was able to immediately resume dirt operations on a large scale without interference.

As may be supposed in this territory, the work of placing is stopped and sometimes postponed for several days because of slippery roads due to the spring snow and rain storms. This trouble has been obviated to some extent by the contractor placing gravel on work roads. Unfortunately, however, the curves, which are the critical points on the roads, constantly have materials high in clay spilled on them, which makes it almost impossible for the contractor to operate after anything more than a light shower.

Water for the fill is supplied from

a small lake located about ½ mile south and above the site. This water is piped to the dam and is distributed on the fill by hose from several tank wagons.

It has been possible, so far, to control the water content of the fill materials fairly accurately. The select core material is tested for moisture content by means of a penetration needle several times each shift. At least one density sample is taken each shift, care being taken to see that a higher proportion of density samples are taken near the abutments where hand tamping is required. Moisture content of the select core materials is kept within 2 per cent of the indicated optimum, determined by the soils testing laboratory. The average dry density for the select core as placed to date is approximately 112 lb. per cu.ft. This is also close to the average for the same material compacted in the laboratory.

Tunnel and spillway work

The tunnel was driven entirely through Pierre shale, work proceeding from both portals. As soon as exposed, the surface of the rock was treated with emulsified asphalt to prevent disintegration and spalling. This method of treatment was quite satisfactory in sections of the tunnel where the shale was somewhat stratified. In the eastern end, however, difficulty was encountered because of blocky ground, and considerable permanent timbering was required.

To avoid shattering of the surrounding ground, shooting was permitted only in the cut holes and in occasional reliever holes, but in no case were shots allowed within 1 ft. of the finished surface. For the most part the shale was broken down by pneumatic hammers.

Lining of the tunnel was done in two parts, half from each portal. The lining plant consists of a 21-E paving mixer, a pneumatic concrete placer, and three portable compressors, all assembled at the portal. Whenever possible the mixer bucket discharged directly into the concrete gun. Invert sections were poured first. Collapsible steel forms were used in both the circular and horseshoe sections of the tunnel.

Construction of the bypass canal, conduit and spillway structures is quite a job in itself, requiring considerable excavation. Concrete for the structures and chute lining is placed from a 27-E paver discharging through chutes.

Construction progress

Construction of the dam proper is now well under way. About 70 per cent of the 2,400,000 cu.yd. embankment has been placed, and the creek has been diverted through the finished tunnel. Pending completion of the tunnel, placement of fill was concentrated in the north part of the dam, but now the south part, in the old creek bed, has been filled up. The spillway and bypass canal are finished. It is expected that the dam will be completed in September or October of this year.

The Ralston dam is being constructed with PWA funds under contract with the United Construction Co., Winona, Minn., by the Denver Board of Water Commissioners, of which George F. Hughes is general manager and H. S. Crocker consulting engineer. Col. Crocker has built up a special staff to handle all the Moffat Tunnel extension work including the gathering works on the western slope, the enlargement and lining of the Moffat pioneer tunnel, the conduits and canals leading from the South Boulder Creek diversion dam, the Ralston dam and pipe line and the West Side filter plant. A. A. Matthews is supervising engineer, E. H. Schneider designing engineer, and the writer is field engineer in charge of the dam. Consultants on the various phases of the work include Charles H. Paul, R. J. Tipton, and Alvord, Burdick & Howson. George C. Leonard is the contractor's superintendent.

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Flood "Sand Boils" Analysed At Cairo, Ill.

IN A PAPER before the A.W.W.A. convention at Buffalo on June 9, C. M. Roos, superintendent of the Cairo Water Company, stated that there was nothing sensational about the "sand boil" phenomenon which was the subject of lurid newspaper accounts of conditions in Cairo during the flood period. These "boils" are ordinary springs which flow only during periods when the normal undergrowth flow to and with the rivers is restricted. Contrary to popular belief, this spring water does not come from the river. This was proved following an exhaustive study by the management of the Cairo Water Co., which included analyses of hundreds of samples of ground waters, sand, soils, geological formations, rainfall, and topography. It had been found that wherever levees protect surrounding areas, sand springs are invariably present during high water.

Water from the sand boils stratum is at low head, rising only about 4 ft. above street level when rivers are at crest stage. Temporary control is provided by surrounding sand boil with a wall of sand bags, preventing the sand from rising to this elevation and diminishing the flow of water. The flow of water is quite limited and damage results only where cavities are formed due to sand escaping and consequent settlement of the clay.

Permanent treatment of sand boil areas does not present difficult engineering problems nor does it involve great expense, said Mr. Roos. The treatment consists of filling underground cavities with cement grout, forcing it down by compressed air of from 50 to 75 lb. pressure. Following the grouting treatment, a blanket of clay is placed over the affected area to raise the surface elevation to a point above which the ground water will not rise during floods.

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New Water Pumps for Los Angeles System

WHILE most of the numerous pumping plants in the Los Angeles water system are automatic the new 121-m.g.d. Fletcher Drive station is to be manually-operated from a bench board. The units vary in capacity to give almost any kind of combination and head. The following are the units: One 3-m.g.d. 175-ft. pump; two 7-m.g.d. 180 ft. pump; one 26-m.g.d. 0 to 25 ft. pump; two 26-m.g.d. 86-ft. pumps and one 26-m.g.d. 66-ft. pump. This equipment replaces part of that now in the Riverside Station. PWA financed projects include three other stations with motor-driven units; two are automatic miniatures supplying small hill districts, the third station, York Boulevard, is also automatic and contains two 1.3-m.g.d. units and two 1.9 m.g.d. pumps.

BOOK NOTES AND REVIEWS

The month's additions to the engineer's reading and reference list

Highway Curves

HIGHWAY SPIRALS, BANKING AND VERTICAL CURVES—By H. Criswell. 166 pp. Published by the Carriers Publishing Co., Ltd., London. Obtainable through the Engineers Bookshop, 168 E. 16th St., New York. Price $2.

A field pocket book for highway engineers dealing with horizontal and vertical alignments of highways for the convenience of those engineers who are responsible for the execution of public works, and who have neither time nor inclination for more than the minimum of calculation. In this respect this book is unusually complete, with tables for use in applying the spiral curve both for office and field work, and includes examples and diagrams not only for standard procedure, but for practically all the intermediate and special problems that may be encountered. It will prove particularly useful to the engineer who wishes to make practical use of the spiral without recourse to theory.—*Review by* E. R. GRIFFIN, *Engineer of Surveys and Plans, North Dakota State Highway Department.*

Sanitation

MUNICIPAL AND RURAL SANITATION—By Victor M. Ehlers and Ernest W. Steel. 441 pp. Published by McGraw-Hill Book Co., New York and London. Price $4.

Sanitation covers a broad field of activity concerning itself as it does with the control of environmental factors which may contribute to disease transmission. The work of the sanitarian, therefore, is highly diversified and becomes more complex as social and economic changes dictate new forms of living. Encompassing the entire range of problems in sanitary engineering in highly informative fashion, the revised edition of the book, "Rural and Municipal Sanitation," first published in 1927, offers a thorough grounding in present-day practices. In addition, to well-rounded discussion of principles of water purification, sewage and refuse disposal, the authors have provided practical information on mosquito and rodent control, plumbing, ventilation, milk and food sanitation, industrial hygiene and swimming pool sanitation. There are also chapters on tourist camps, housing, noise abatement, light and general school sanitation. Particularly helpful to readers who desire further information on specific subjects is the bibliography that follows each chapter.

Municipal Year Book, 1937

THE MUNICIPAL YEAR BOOK, 1937. International City Managers Association, 850 E. 58th St., Chicago. C. E. Ridley and O. S. Nolting, editors. 599 pp. 1937. $5.

This issue of the Municipal Year Book contains more information than any previous issue, being more than twice as large as the first issue (1934), and more than 100 pages larger than the 1936 volume. In the first section of the book, 23 leading authorities analyze and interpret the specific events and developments of 1936 in as many fields of municipal administration. Part II carries a discussion of trends in urban population with special emphasis on developments since 1930, prepared by the U. S. Bureau of the Census. Another article summarizes 1936 federal legislative and administrative developments which affect municipalities. Also, for each of the 950 cities of over 10,000 population, there are given data on population, area, form of government, utilities owned and operated, etc.

Municipal personnel, the title of section III, contains tabulated personnel data for cities over 10,000 population. Also included are discussions of city-wide organizations for municipal employees, credit unions for local government employees, professionalization of the municipal service, and a directory of chief city officials in 950 cities.

Because of the momentous influence on municipal administration of the activities of the Federal Emergency Agency, Part IV of the book, municipal finance, is largely devoted to discussion on financing relief and recovery. A new feature in the book is a section containing a list of sources of standards and specifications. A valuable compendium of services and information available from over 150 federal agencies and as many national organizations is also included.

Appraisal Manual

BOECKH'S MANUAL OF APPRAISALS—Second Edition—By E. H. Boeckh. E. H. Boeckh Associates. 267 pp. Published by The Rough Notes Co., Inc., Indianapolis. Price $5.

The optimistic objective undertaken in this manual—to simplify and reduce appraisals of buildings to the formula process—merits considerable praise, and in the hands of an experienced estimator with a broad construction background, might prove a distinct contribution to the science of appraising. However without the "feel" of buildings and the confidence of treading familiar ground, it is not easy to teach construction values by the "formula and picture method."

The Boeckh method would have the appraiser determine immediately the physical characteristics of a structure and identify the resultant as expensive, good, average, or cheap; finding a similar specification in the *Manual* is the next step. This is no easy task in the hands of a scrupulous investigator, as even in the absence of doubt as to materials and possibly workmanship, there is the more subtle distinction of planning and design efficiency. A well-planned building, apart from a longer expectancy of assured income, could conceivably have a lower-than-average initial cost. Purely from a construction cost basis, forethought in planning could thus be over-appraised physically. Such a factor should be considered only from the viewpoint of appraisal by income. But conversely, poorly planned structures should be penalized in their physical valuations, as inevitably sooner or later funds must be spent to place these structures in the competitive running. To what extent Major Boeckh's formulas provide for the efficiency factor is not clearly defined, and therefore the *Manual* would be improved by a chapter devoted to this feature.

The average cost indexes for the ten types of building construction are

corrected for the particular buildings under analysis by the application of various synthetic indexes. The latter are integrations of eight current local prices of labor and material and five miscellaneous index data. The derivation of the basic cubic foot prices is not given, but it is assumed that these values were determined by a general method of comparison, with the accompanying illustrations to give a key thereto.—*Reviewed by* F. J. KNOX. *New York City.*

New Orleans Foundations

SOME DATA IN REGARD TO FOUNDATIONS IN NEW ORLEANS AND VICINITY—Collected and Compiled by the Soil and Foundation Survey, a project of the Works Progress Administration of Louisiana. 277 pp. Published by the Works Progress Administration of Louisiana, New Orleans, La.

A need long felt in many cities for comprehensive collection of data on foundation conditions and building settlements has been met in the case of New Orleans by an investigation carried out by the Works Progress Administration at the suggestion of the Louisiana Engineering Society. The results, just published in a large volume, present a great amount of information, including history and geology of the region, records of 239 test borings carried to depths as great as 400 ft., and records of the foundation construction and settlement of 70 or 80 buildings, stacks, seawalls and bridges. In view of the deep, soft ground in the New Orleans region and the numerous instances of settlement, the record promises to be of permanent value in connection with all future foundation work in the region.

MISCELLANEOUS NOTES ON BOOKLETS AND REPRINTS

AUTOMOBILE FACTS and Figures, 1937 Edition. A compilation of statistics concerning motor transportation in this country, much of it compiled by states; prepared by the Automobile Manufacturers Association, 366 Madison Ave., New York.

WEATHERING RESISTANCE of Concrete: A report on a study made at Rensselaer Polytechnic Institute, Troy, N. Y. and published as Engineering Science Series No. 53.

A POCKET REFERENCE BOOK for highway engineers giving concise information concerning asphalt as a paving material has been published by the Asphalt Institute, 801 Second Ave., New York City.

TIMBER UTILIZATION throughout the world is the subject of a pamphlet put out by the Comite International du Bois, Singerstrasse 27, Vienna, Austria, which gives (in English) a brief summary of recent developments in the use of timber throughout the world. Price, 4 shillings.

TESTS ON THE USE of rubber tires and steel wheels on farm tractors, conducted at the Agricultural Experiment Station, Montana State College, Bozeman, Mont., have been published as Bulletin No. 339 of the Experiment Station. Such subjects as the effect of the type of tire, size and inflation of rubber tires on drawbar pull and fuel consumption are covered.

A SUPPLEMENT to the "Douglas Fir Use Book" has been published by the West Coast Lumbermen's Association, Stuart Building, Seattle, Wash. It relates to bolted joints of Douglas fir with tables of safe loads on common bolts.

REGULATIONS for lighting bridges revised to 1937 may be obtained from the Superintendent of Documents, Washington, D. C. Price, 10c.

STRUCTURAL TIMBER specifications have been issued by the Canadian Engineering Standards Association, 178 Queens St., Ottawa, as No. A-43-1937. Price, 25c.

HYDRAULICS and Pneumatics of Plumbing Drainage Systems is the title of Bulletin 10 of University of Iowa, Institute of Hydraulic Research, Iowa City, wherein is described studies defining minimum drain, stack, and vent sizes so that they may be designed on a rational basis. Results are given of tests on flow of water down partly full vertical pipes and pneumatic disturbances which set up large pressure differentials that may break water seals in fixtures.

BENDING STRENGTH of thin-walled cylindrical tubes is the subject of an English edition of Report No. 9, Structural Research Laboratory, Royal Technical College, Copenhagen.

THE RESULTS of Kentucky's new revenue program have been made the subject of a pamphlet, special report No. 1, Department of Revenue, Commonwealth of Kentucky, Frankfort, Ky.

SEWAGE and industrial waste treatment, a symposium of papers at the 1936 Ohio Conference on Sewage Treatment, are published in the tenth annual report of the conference. Copies are available at $1.25 each; address orders to Mr. J. H. Wenger, treasurer, 41 West Home St., Westerville, Ohio.

AIR CONDITION EQUIPMENT markets are analyzed in a report issued by the Dept. of Commerce which presents water supply data in cities over 100,000 population. Copies at 10c. each can be ordered from the Bureau of Foreign and Domestic Commerce, Washington, D. C.; ask for Market Research series No. 16.

NEW PUBLICATIONS

CITY OF CHARLESTON YEAR BOOK—1932-1935. Published by the city. Obtainable from Burnet R. Maybank, Mayor, Charleston, S. C.

TECHNOLOGICAL TRENDS AND THE NATIONAL POLICY—Report of the Subcommittee on Technology to the National Resources Committee. 388 pp. For sale by the Superintendent of Documents, Washington, D. C. Price $1 (paper cover).

BRIDGES IN HISTORY AND LEGEND—By Wilbur J. Watson and Sara Ruth Watson. 248 pp. Published by J. H. Jansen, Caxton Bldg., Cleveland, Ohio. Price $3.50.

MANNING FORMULA TABLE — For the Solution of Pipe Problems. By Horace Williams King. 351 pp. Published by McGraw-Hill Book Co., New York and London. Price $5.

HOW PROFITABLE IS BIG BUSINESS?—By the Corporation Survey committee of the Twentieth Century Fund, Inc. 201 pp. Published by Twentieth Century Fund, Inc., New York. Price $2.00.

1001 WAYS TO USE CONCRETE—Edited by Harold O. Hayes. 238 pp. Published by the Popular Mechanics Press, Chicago, Ill. Price $5.

PRINCIPLES OF MECHANICS OF FROZEN GROUNDS (Printed in Russian)—By N. A. Tsitovitch and M. J. Soumgin. 432 pp. Published by the Academy of Sciences of the U.S.S.R. Press, Leningrad, Russia. Price not stated.

APPLIED FLUID MECHANICS — By Morrough P. O'Brien and George H. Hickox. 360 pp. Published by McGraw-Hill Book Co., Inc., New York and London. Price $3.50.

THE WEEK'S EVENTS

Continued from page 169

Engineer Societies Oppose Unionization of Engineers

Efforts to compel engineers to join "vertical" labor unions against their will are opposed in resolutions adopted recently by the Western Society of Engineers and in a circular letter sent out recently by the Engineering Council of Indiana. Action by these societies grew out of a strike of engineers in the plant of the Universal Oil Products Co., builders of oil cracking plants, called by the Federation of Architects, Engineers, Chemists and Technicians, an affiliate of the C.I.O.

The board of directors of the Western Society of Engineers, while expressing itself as friendly to the best interest of labor and as not opposed to unions comprised of voluntary membership of common and skilled labor, expressed strong opposition to any demand that professional engineers should become members of any labor union and condemned activities of a coercive nature seeking to compel engineers to join unions under threat of loss of employment or any other invasion of their rights as citizens.

The circular letter of the Indiana Engineering Council is in similar tone. It is the outgrowth of a letter from Arthur V. Sheridan, president, National Society of Professional Engineers, to the state societies of professional engineers urging them to concerted action to oppose involuntary membership of engineers in vertical unions and to assert the right of professional men to exemption from being classed with industrial labor groups.

Protesting against the action of the board of directors of the W.S.E., the Chicago chapter of the Federation of Architects, Engineers, Chemists and Technicians states: "It is not the policy of the C.I.O. to force engineers into vertical unions, engineers who desire to join a union are referred to our organization unless they specifically desire to join an industrial union, in which case we waive our jurisdiction."

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Propose to Shortcut River Below New Orleans

Proposal that the Mississippi River Commission make a five mile cut-off across a 22 mile river bed immediately below New Orleans, converting "English Turn" Point into an island, has been made to Brigadier General Harley Ferguson by Harry Jacobs, chief, Louisiana state board of engineers. Such a shortcut would lower river stages at New Orleans and provide a shorter sailing distance for steamships using the port of New Orleans. Bends in the river at New Orleans would probably require revetment to offset augmented river current, according to Mr. Jacobs. Local authorities would provide right of way.

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Harry Parker Hammond Penn State Dean

Harry Parker Hammond, head of the department of civil engineering at Polytechnic Institute of Brooklyn, has been appointed dean of the School of Engineering at Pennsylvania State College. A past president of the Society for the Promotion of Engineering Education, Dr. Hammond succeeds Dr. Robert L. Sackett, who retired July 1 after 22 years of service.

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Erosion Control Survey Covers 516,000 Acres

Surveys to determine erosion conditions, soil types, slopes, and present land uses have been completed for more than 516,000 acres of Iowa farmland. These surveys are designed to secure basic information for use in making erosion control plans for Iowa farms. Aerial photographs have been used as maps on which survey data is recorded for approximately 416,000 of the acres surveyed in the state. Plane table maps were made of the remaining 100,000 acres.

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Gibb Gilchrist New Texas Engineering Dean

Gibb Gilchrist, Texas state highway engineer, will assume his new duties as dean of the College of Engineering of the Texas Agricultural and Mechanical University Sept. 1. Mr. Gilchrist first became associated with the Texas highway department in 1919 and has served as chief engineer for the past twelve years. He is president of the Association of State Highway Officials this year.

Technical Union Joins C.I.O.

The Cincinnati local No. 50 of the International Federation of Technical Engineers', Architects' and Draftsmen's Union, affiliated with the A. F. of L. has voted to return their A. F. of L. charter and join the Federation of Architects, Engineers, Chemists and Technicians affiliated with the C.I.O.

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Chicago Outer Bridge Work Delayed by Strike

Due to inability to obtain steel posts for safety barricades, the opening of Chicago's new Outer Drive bridge will be delayed about two months. Original opening was scheduled for Aug. 1. The safety gates to keep autos from falling into the bridge well when the leaves are up have been caught in steel strikes. These barriers consist of a series of iron posts about a foot in diameter spaced at narrow intervals to prevent a car from passing between them. They will rise from the floor of each bridge entry to a height of about 2½ ft. when the bridge is up.

CALENDAR OF MEETINGS

AMERICAN ASSOCIATION OF WATER WELL DRILLERS, annual convention, Hotel Pennsylvania, New York, Aug. 24-26.

CANADIAN GOOD ROADS ASSOCIATION, annual convention, St. Andrews-by-the-Sea, N. B., Sept. 7-9.

ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual convention, Boston, Sept. 27-30.

AMERICAN PUBLIC WORKS ASSOCIATION, annual conference, Atlanta, Biltmore Hotel, October 4, 5, 6.

AMERICAN PUBLIC HEALTH ASSOCIATION, annual meeting, New York, Oct. 5-8.

AMERICAN WATER WORKS ASSOCIATION, Central States Section, Dearborn, Mich., August 18-20; North Carolina Section, Wilmington, N. C., August 26-28; Rocky Mountain Section, Santa Fe, N. M., September 20-22.

NORTH CAROLINA SOCIETY OF ENGINEERS, annual convention, Wrightsville Beach, N.C., Aug. 13-14.

MONTANA BITUMINOUS CONFERENCE, annual conference, Glacier National Park, Sept. 7-9.

NEW ENGLAND WATER WORKS ASSOCIATION, annual convention, Poland Spring, Me., September 21-24.

PERSONAL

THOMAS J. BARTRUG has been appointed city engineer of Kenova, W. Va.

ROBERT J. ROSS has been named city engineer at Hartford, Conn.

VERNON WYATT is engineer for Gibson county, Tenn.

WILLIAM A. D. WURTS has been appointed assistant city engineer of Hartford.

W. H. WISELY is assistant sanitary engineer for the Illinois state department of public health.

W. S. A. SALLEE is now San Juan county engineer at Friday Harbor, Wash.

WILLIAM J. RUSH has been appointed engineer in charge of construction of the new Worthington, Ohio, post office.

J. L. HENDERSON has been appointed city engineer and water superintendent at Vancouver, Wash.

Col. J. H. CARRUTH becomes district engineer for the Norfolk, Va., U. S. Engineers, effective Aug. 1.

TOM C. MCEWEN is now director of the Tennessee state highway planning division at Nashville.

FREDERICK J. DIXON, Bridgeport, has been appointed chief engineer of the state department of public works.

WILLIAM MCP. FULLER, director of the WPA in Colorado Springs, is acting director in the Denver area.

A. J. ALLMAN, Tiffin, Ohio, has been appointed a director of the Scioto-Sandusky conservancy district.

FRANCOIS DORE is now divisional chief at Montreal for the Quebec Provincial Department of Roads.

RICHARD SAINT has been appointed Quebec's divisional chief by the Provincial Department of Roads.

HOWARD W. SCHULTZ has been appointed chief engineer of the Ohio Rubber Co., Willoughby, Ohio.

C. E. BURLESON, Pinellas County, Fla., engineer for 20 years, resigned recently to enter private practice.

R. A. MCALLISTER, formerly resident engineer at Sault Ste. Marie, has been appointed deputy minister of the department of public works in Ontario.

S. R. GIST FINLEY has moved to Chattanooga to take up his duties as chief engineer for the Chattanooga Public Power Board.

R. B. ELSBERRY has been appointed acting district manager of the San Carlos Irrigation and Drainage District, Ariz.

PHILLIPS B. MOTLEY, engineer of bridges for the Canadian Pacific Railway, retired June 30 after 45 years with the company.

A. R. KETTERSON, assistant engineer of bridges for the Canadian Pacific Railroad, has been appointed engineer of bridges.

W. B. MILLARD, JR., vice-president of Omaha National Bank, has been appointed director for the Metropolitan Utilities District at Omaha.

ROBERT J. STRASS is resident engineer inspector for the Resettlement Administration, Monroe, Jackson, and Juneau counties, Wisconsin.

HARRY F. LYTLE has been named to supervise WPA engineering activities in ten counties of eastern Washington, with headquarters at Spokane.

CURTIS L. MCKINNON has been elected chairman of the Iowa highway commission. He has been a member of the commission for two years.

R. S. CALLAND is now division engineer in charge of the Friant section of the Central Valleys project in California.

TOM E. MORRIS, maintenance engineer at Jackson, Tenn., has been transferred to Knoxville, where he will be chief engineer of the first division.

J. A. HADLEY has been appointed chief engineer of the fourth division of the Tennessee highway commission at Jackson.

A. D. STANLEY, material and construction engineer in the Idaho state highway department, has resigned his position effective July 31.

C. E. SHERMAN of the engineering college, Ohio State University, has been appointed first chief engineer of the Scioto-Sandusky conservancy district.

CHARLES R. HAILE, former Harris county engineer at Houston Texas, has opened a consulting engineering office at Houston.

PHILIP L. PRATLEY, of Monsarrat & Pratley, consulting structural engineers of Montreal, was awarded the Duggan medal at the recent Semi-Centennial meeting of the Engineering Institute of Canada.

OBITUARY

CURTIS L. DOBBINS, 74, building contractor, died July 11 in Bucyrus, Ohio.

HENRY M. MARTIN, retired contractor, died in Birmingham July 9 at the age of 75.

WILLIAM PORTER, superintendent for the Reganhardt Construction Co., died recently in St. Louis.

EDGAR M. HULCE, 56, highway engineer for the Bureau of Public Roads at Missoula, Mont. for the past 17 years, died recently.

JAMES L. KIMBROUGH, 57, president of the Indiana Bridge Co., and former head of the Indiana Manufacturers Association, died July 12 in Muncie, Ind.

CLARK B. WHALEY, director of right-of-way and purchases for the Connecticut state highway department, died July 3 in Groton, Conn., at the age of 63.

FREDERICK J. WEBER, inventor of the modern grain elevator and former president of the Steel Storage & Elevator Construction Co., of Buffalo, died July 8 in Daytona Beach, Fla.

RICHARD CLOUGH, 88, pioneer railroad builder, died July 12 in Colorado Springs. As a contractor, he did work on the Denver & Rio Grande Western, the Colorado & Southern, the Midland Terminal and the Great Northern railways in early days.

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Air Map of TVA Completed

Completion of a map recording the position of every town, road, bridge and wooded area in the Tennessee Valley, has been announced by the TVA. The U. S. Geological Survey assisted in the preparation of the map. The finished map is made of 783 quadrangles, each covering about 60 sq. miles of territory and scaling 2,000 ft. to the inch.

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David S. Beyer Dies

Davis S. Beyer, 57, vice president and chief engineer of the Liberty Mutual Insurance Co., of Boston, died in Newton, Mass. recently. Mr. Beyer was a writer and lecturer on safety and accident prevention and was the author and producer of several motion pictures on safety and accident prevention. He was also interested in dust control for the prevention of silicosis.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

TRANSMISSION LINES, NEBRASKA

OWNER: Eastern Nebraska Public Power District; H. H. Hennington, Consulting Engineer.

PROJECT: Construction of Cass Co. portion of 421 miles transmission lines for Eastern Nebraska Public Power District's rural electrical distribution system, financed through REA.

BIDS: Seven bids were opened June 16, 1937 containing alternatives for both copper and aluminum conductors with SYP poles and three transformer types. One bid only was received for these alternatives with WC pole units, and for Kuhlman transformers as compared with General Electric type. Based on copper conductors, SYP poles and GE transformers, six bids ranged from a low of $420,410 to a high of $442,116. With Kuhlman transformers, the low bid is reduced $1,044. On aluminum conductors, SYP poles and GE transformers, seven bids ranged from $392,189 to $418,585; with optional transformer types, from $387,459 to $413,470.

LOW BIDDERS: (copper conductors)

1. Chapin Const. Co., Wichita, Kan. $420,410
2. Federal Engineering & Const. Co., Kansas City, Mo. 429,661
3. C. F. Lytle, Sioux City, Ia. 434,549

Note—On the aluminum conductor alternative with SYP poles and GE transformers, the three low bidders were: Chapin Const. Co., Wichita, Kan., $392,189; Charles Robeck Const. Co., Omaha, Neb., $393,182; Federal Eng. & Const. Co., Kansas City, Mo., $402,652. With optional type transformers, the three low bidders were: Chas. Robeck Const. Co., Omaha, Neb., $387,459; Chapin Const. Co., Wichita, Kan., $387,475; Federal Eng. & Const. Co., Kansas City, Mo., $396,883.

Item	Quan.	Unit Prices (1)	(2)	(3)
ITEM A—(COPPER CONDUCTOR PER 1,000-FT. UNITS)				
1. H. D. copper, No. 1/0, 7 str. bare	1,483	$71.94	$71.72	$74.52
2. H. D. copper, No. 2, 3 str. bare	108	46.11	45.65	49.49
3. Copperweld wire, No. 6A	3,915	22.90	24.13	23.90
4. Copperweld wire, No. 8A	486	17.97	18.68	18.31
5. TBWP copper wire, No. 4	1	47.37	37.10	38.30
6. TBWP copper wire, No. 6	35.6	35.13	26.76	27.12
7. TBWP copper wire, No. 8	9	27.95	19.51	19.57
ITEM B (SP POLE UNITS, COPPER CONDUCTOR)				
8. Poles, SP, 25 ft. 6 in.	100	7.40	8.84	7.44
9. Poles, SP, 30 ft. 7 in.	1,608	8.46	9.69	8.10
10. Poles, SP, 30 ft. 6 in.	2,400	9.31	10.36	9.36
11. Poles, SP, 30 ft. 5 in.	131	12.10	11.74	10.20
12. Poles, SP, 30 ft. 4 in.	736	12.29	12.75	11.46
13. Poles, SP, 35 ft. 7 in.	426	11.70	11.33	9.72
14. Poles, SP, 35 ft. 6 in.	650	13.33	12.95	11.10
15. Poles, SP, 35 ft. 5 in.	310	15.62	14.20	12.96
16. Poles, SP, 35 ft. 4 in.	126	16.34	15.49	14.06
17. Poles, SP, 35 ft. 3 in.	32	20.15	18.61	17.34
18. Poles, SP, 40 ft. 6 in.	581	16.28	14.19	13.32
19. Poles, SP, 40 ft. 5 in.	227	19.45	16.06	15.78
20. Poles, SP, 40 ft. 4 in.	41	23.13	18.16	17.88
21. Poles, SP, 40 ft. 3 in.	226	25.02	22.37	21.08
22. Poles, SP, 45 ft. 6 in.	92	20.92	16.83	15.66
23. Poles, SP, 45 ft. 5 in.	15	24.12	18.99	18.30
24. Poles, SP, 45 ft. 4 in.	9	28.59	21.87	21.78
25. Poles, SP, 45 ft. 3 in.	8	32.67	26.12	25.20
26. Poles, SP, 50 ft. 5 in.	15	31.22	23.73	22.68
27. Poles, SP, 50 ft. 4 in.	5	36.37	28.11	27.00
28. Poles, SP, 50 ft. 3 in.	6	41.02	31.53	31.92
29. Poles, SP, 50 ft. 2 in.	6	46.73	35.31	37.20
ITEM D (POLE TOP ASSEMBLY UNITS, COPPERWELD CONDUCTOR)				
30. P. T. assembly, type A	954	4.03	4.71	5.00
31. P. T. assembly, type AA	140	5.64	6.04	6.83
32. P. T. assembly, type A1	63	8.60	7.51	9.50
33. P. T. assembly, type A2	16	10.26	8.89	10.82
34. P. T. assembly, type A3	13	21.30	18.45	22.80
35. P. T. assembly, type A4	1	26.27	17.33	22.07
36. P. T. assembly, type A5	28	16.97	7.66	9.74
37. P. T. assembly, type A7	3	14.30	8.98	11.17
38. P. T. assembly, type B	4,289	1.34	2.01	1.68
39. P. T. assembly, type B1	630	1.96	2.30	2.50
40. P. T. assembly, type B2	105	3.68	3.87	4.30
41. P. T. assembly, type B3	122	8.66	7.38	8.84
42. P. T. assembly, type B4	273	5.88	4.63	5.85
43. P. T. assembly, type B5	45	6.25	4.85	6.05
44. P. T. assembly, type B6	497	4.70	3.86	4.30
45. P. T. assembly, type RR	12	13.76	8.17	10.48
46. P. T. assembly, type RR1	20	8.86	3.25	3.88
47. P. T. assembly, type SA	105	5.82	4.90	6.12
48. P. T. assembly, type F	5	3.28	3.50	4.08
49. P. T. assembly, type FF	2	5.27	5.02	6.15
50. P. T. assembly, type F1	2	7.22	6.54	8.24
51. P. T. assembly, type F2	2	6.80	6.42	7.70
52. P. T. assembly, type F3	2	16.10	12.74	15.88
53. P. T. assembly, type F4	1	17.71	14.81	18.63
54. P. T. assembly, type F5	1	10.59	7.02	8.81
55. P. T. assembly, type F6	1	8.15	6.42	8.05
ITEM E (ALUMINUM CONDUCTOR PER 1,000-FT. UNITS)				
56. ACSR, bare, 6/1, No. 3/0	1,483	62.50	61.50	64.63
57. ACSR, bare, 6/1, No. 1/0	108	41.67	39.80	43.46
58. ACSR, bare, 7/1, No. 4	3,915	18.19	19.66	19.03
59. ACSR, bare, do.	486	18.19	19.66	19.03
60. TBWP copper wire, No. 4	1	47.37	37.10	38.30
61. TBWP copper wire, No. 6	35.6	35.13	26.76	27.12
62. TBWP copper wire, No. 8	9	27.95	19.51	19.57
ITEM I (POLE ASSEMBLY UNITS)				
63. P. A. unit, type C 101	6	.67	.84	.79
64. P. A. unit, type C 201	171	1.04	1.17	1.30
65. P. A. unit, type C 301	15	1.41	1.53	1.81
66. P. A. unit, type C 102	1	.96	.95	.93
67. P. A. unit, type C 202	2	2.02	1.38	1.56
68. P. A. unit, type C 302	2	2.68	1.82	2.21
69. P. A. unit, type C 103	1	1.37	1.17	1.23
70. P. A. unit, type C 203	1	2.04	1.81	2.16
71. P. A. unit, type C 303	1	2.71	2.49	3.11
72. P. A. unit, type C 104	6	3.04	1.84	2.37
73. P. A. unit, type C 204	14	5.08	3.18	4.28
74. P. A. unit, type C 304	5	5.62	4.52	6.19
75. P. A. unit, type C 105	18	1.47	1.12	1.16
76. P. A. unit, type C 205	228	2.34	1.73	2.04
77. P. A. unit, type C 305	91	3.21	2.34	2.91
78. P. A. unit, type C 206	1	10.22	4.56	5.72
79. P. A. unit, type C 306	5	10.76	5.02	6.44
80. P. A. unit, type C 307	203	3.22	1.81	2.10
81. P. A. unit, type HG	28	8.54	8.59	8.34
82. P. A. unit, type SG	350	6.68	5.77	5.12
83. P. A. unit, type DG	14	15.38	11.04	8.45
84. P. A. unit, type DG1	46	5.88	9.91	6.33
85. P. A. unit, type DG1A	35	7.43	11.11	8.41
86. P. T. unit, type DG2	770	5.58	10.44	7.13
87. P. T. unit, type DG2A	315	7.13	11.64	9.21
88. P. T. unit, type RF	5	142.41	140.00	171.35
89. P. T. unit, type SSW	18	17.87	14.00	5.31
90. P. T. unit, type ASW	3	216.27	122.00	155.45
91. P. T. unit, type GA	50	5.36	6.38	4.03
ITEM J (MISCELLANEOUS)				
92. Clear right of way, 1,000 ft. units	88	40.00	45.00	60.00
ITEM K (SERVICE UNITS)				
93. TBWP, No. 6 (2–50 ft.)	2	3.89	3.90	4.50
94. TBWP, No. 6 (2–75 ft.)	2	5.03	5.06	5.70
95. TBWP, No. 6 (2–100 ft.)	24	6.16	6.24	6.95
96. TBWP, No. 6 (2–125 ft.)	20	7.30	7.40	8.15
97. TBWP, No. 6 (2–150 ft.)	52	8.43	8.56	9.30
98. TBWP, No. 8 (2–50 ft.)	1	3.19	3.17	3.70
99. TBWP, No. 8 (2–75 ft.)	1	3.97	3.98	4.60
100. TBWP, No. 8 (2–100 ft.)	53	4.75	4.78	5.40
101. TBWP, No. 8 (2–125 ft.)	39	5.53	5.50	6.35
102. TBWP, No. 8 (2–150 ft.)	36	6.31	6.39	7.15
103. TBWP, No. 6 (3–50 ft.)	42	5.34	5.58	6.40
104. TBWP, No. 6 (3–75 ft.)	68	6.04	7.33	8.25
105. TBWP, No. 6 (3–100 ft.)	185	8.74	9.08	10.05
106. TBWP, No. 6 (3–125 ft.)	142	10.45	10.83	11.80
107. TBWP, No. 6 (3–150 ft.)	316	12.15	12.59	13.50
108. TBWP, No. 4 (3–50 ft.)	1	6.85	7.13	8.10
109. TBWP, No. 4 (3–75 ft.)	3	9.30	9.66	10.65
110. TBWP, No. 4 (3–100 ft.)	8	11.75	12.18	13.20
111. TBWP, No. 4 (3–125 ft.)	6	14.21	14.72	15.70
112. TBWP, No. 4 (3–150 ft.)	21	15.66	17.24	18.10
ITEM K (TRANSFORMERS—EXCEL. ALTER.)				
113. Transformer, type E1, 1½ kva.	23	69.38	66.95	79.70
114. Transformer, type E1, 3 kva.	18	81.45	77.49	93.00
115. Transformer, type E1, 5 kva.	3	104.62	97.46	118.45
116. Transformer, type E1, 7½ kva.	1	133.98	119.72	146.70
117. Transformer, type E2, 1½ kva.	262	69.18	66.24	78.90
118. Transformer, type E2, 3 kva.	223	81.25	76.78	92.20
119. Transformer, type E2, 5 kva.	15	104.42	96.75	117.65
120. Transformer, type E2, 7½ kva.	1	133.78	119.01	145.90
121. Transformer, type E4, 1½ kva.	1	69.38	66.95	79.70
122. Transformer, type E4, 3 kva.	1	81.45	77.49	93.00
123. Transformer, type E4, 5 kva.	1	104.62	97.46	118.45
124. Transformer, type E5, 1½ kva.	210	69.18	66.24	78.90
125. Transformer, type E5, 3 kva.	125	81.25	76.78	92.20
126. Transformer, type E5, 5 kva.	25	104.42	96.75	117.65
127. Transformer, type E5, 7½ kva.	1	133.78	119.01	145.90

(*Additional Contract Unit Prices on second following page*)

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